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THE CENTENNIAL BUILDINGS.

We have already placed before our readers views of the Main Building and the Art Gallery, now being erected for the Centennial Exposition, in Fairmount Park, Philadelphia, Pa.; and we herewith publish a view of the Horticultural Building, a large conservatory: an extremely ornate and commodious building, which is to remain in permanence as an ornament of Fairmount Park. It is located on the Lansdowne Terrace, a short distance north of the Main Building and Art Gallery, and has a commanding view of the Schuylkill river and the northwestern portion of the city. The design is in the moresque style, the principal materials externally being iron and glass. The length of the building is 383 feet, width 193 feet, and hight, to the top of the lantern, 72 feet.

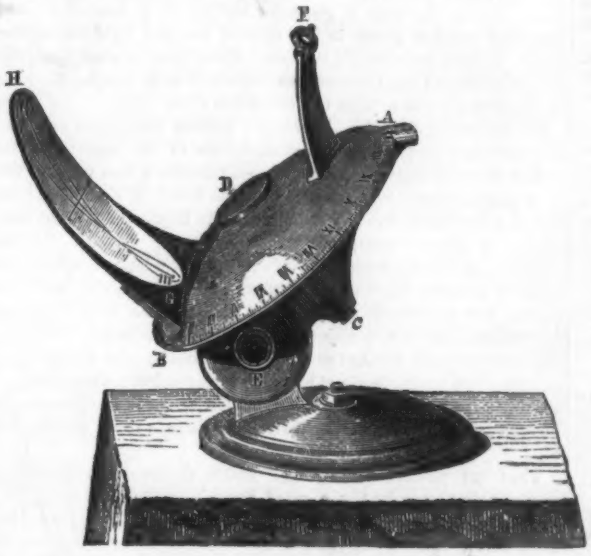
The main floor is occupied by the central conservatory, 230 by 80 feet, and 55 feet high, surmounted by a lantern 170 feet long, 20 feet wide, and 14 feet high. Running entirely around this conservatory, at a hight of 20 feet from the floor, a gallery 5 feet wide will be erected. On the north and south sides of this principal room are to be four forcing houses for the propagation of young plants, each of them 100 by 30 feet, covered with curved roofs of iron and glass. Dividing the two forcing houses in each of these sides is to be a vestibule 30 feet square. At the center of the east and west ends are similar vestibules, on either side of which will be the restaurants, reception room, offices, etc. From the vestibules ornamental stairways will lead to the internal galleries of the conservatory, as well as to the four external galleries, each 100 feet long and 10 feet wide, which are to surmount the roofs of the forcing houses. These external galleries are to be connected with a grand promenade, formed by the roofs of the rooms on the ground floor, which have a superficial area of 1,800 square yards.

The east and west entrances will be approached by flights of blue marble steps from terraces 80 by 20 feet, in the center of each of which an open kiosque, 20 feet in diameter, is to stand. The angles of the main conservatory are to be adorned with eight ornamental fountains. The corridors which connect the conservatory with the surrounding rooms, open fine vistas in every direction.

In the basement, which is of fireproof construction, are the kitchen, store rooms, coal houses, ash pits, heating arrangements, etc.

A SOLAR CHRONOMETER.

In the accompanying illustration is represented a solar



FLECHET'S SOLAR CHRONOMETER.

chronometer, recently invented by M. Fléchet, from which, according to *La Nature*, the hour may be determined with accuracy. It consists of a rounded disk, A, divided into 24 hours and their fractional parts. This turns about an axis, C D, which is placed parallel to the earth's axis according to the latitude of the place, by means of the point, E. F is a lens, located in the center of an exactly spherical concave plate and capable of adjustment toward the sun.

When the instrument is arranged so that the axis is inclined as above noted, the disk, A B, is turned so that the image of the sun produced by the lens, F, falls on the arc, *m n*. The hour is given by the pointer at A, and the corresponding hour mark on the disk. The instrument is said to be accurate within one quarter or one third of a minute.

The Steam Donkey.

At a recent *séance* of the French Academy of Sciences, some interesting particulars about a new locomotive of M. Fortin Hermann were given: Its propulsion is produced by the rising and falling of six articulated feet, which strike the ground or rails something like the feet of a quadruped. These feet are arranged in two groups. three support the fore part of the machine, and the other three the after part. The two middle feet are connected together by a horizontal shaft; the four others are independent, and strike the ground successively in such a manner that, while the middle feet move at a moderate pace, the others have a highly accelerated motion. Each of these groups of three feet is affixed to a single trunk. The force of the steam is applied in such a way as to drive these feet toward the ground.

The experiments made by the Eastern Railway Company at Paris with one of these machines have demonstrated that, when the feet are shod with soles of india rubber weighing one kilogramme (2·2 lbs.) each square centimeter (4-10th inch), an adherence to the rails or road is obtained equal to three fourths of the weight of the machine itself. In the ordinary locomotive this adherence does not go beyond one fifth of the weight of the machine; it may be added that this adherence is, in point of fact, variable; on wet or damp rails it is not more than one half; but in the newly invented locomotive of M. Hermann, although the state of the rails or ground will always have an influence, as in the case of the machines in actual use, it will always be greatly superior. The experi-

CENTENNIAL HORTICULTURAL BUILDING PHILADELPHIA PA.

ments made thus far prove that this new machine will drag on ordinary roads, or on rails, a train four times as heavy as the ordinary trains; the cost of this augmented train will not, it is said, vary materially from that of the ordinary machines with the usual trains when used on equal grades; but the increased adhering power of the new locomotive will permit of the employment of a lighter built machine for the usual trains, as well as the power to surmount steeper grades than are usual on the railways of the present construction.

This new system of M. Fortin-Hermann enlarges very greatly the capacities of all locomotives for any roads, and will allow of passing through ground where roads have not been constructed, and up grades of one foot in ten.

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THE EDUCATION OF SIGHT.

As the reader's eyes rest upon this page of the SCIENTIFIC AMERICAN, a very complex impression is conveyed to his mind. He perceives a contrast of light and shade, the white paper and the black ink. The dark portions exhibit various forms, which stand in definite positions with reference to each other and to the reader. The paper lies at a recognized distance from the reader's eye. It has form and size, a certain degree of smoothness, and certain roughnesses indicating lines of print on the reverse side. Further looking will discover a succession of black forms—letters, words, etc.—conveying the ideas now in the writer's mind.

How much of all this is strictly speaking, seen? How much is the result of ulterior processes?

Paradoxical as it may seem, the reader's eyes report only the first mentioned contrasts of light and shade: all the rest is extravisual. In other words, when we look at a complex object, say a landscape, the eye distinguishes light and shade only; the situation, direction, distance, form, size, etc., of the several objects which produce lights and shades, we have to determine by other means, for the discovery of which we are indebted to the patients of Cheselden, Home, Wardrop, Franz, and others, who were born blind and given the power of vision in later years by a surgical operation.

In all these cases, we believe, the cure consisted in the removal of an overlying growth which eclipsed the otherwise perfect organ of vision. In each case the patient was sufficiently mature to report the exact nature of the sensation aroused by the act of sight on the part of a perfect but uneducated eye—uneducated, that is, in respect to motion, and unaided by any knowledge acquired by the other senses. Their experiences, therefore, clearly demonstrate the scope of pure vision in all persons, and also the origin of the ideas of form, size, distance, etc., which seem to arise in our minds through simple seeing.

Of the earliest patient, Cheselden's, it is recorded that "he knew not the shape of anything, nor any one thing from another, however different in shape or magnitude," and the same is substantially true of all the others.

Ten minutes after his eyes were opened, Home's patient was shown a round piece of card, and was asked the shape of it. He could not tell till he had touched it. The next moment a square card was shown him, and he said it was round like the other. He said the same of a three-cornered card. He was then asked if he could find a corner on the square card. It was only by much thinking that he decided that the card had a corner, after which he readily recognized the other three corners.

An exceedingly instructive subject was a lady operated on by Wardrop: she could merely distinguish a very light from a very dark room, so complete was her blindness. At first she saw only patches of light and shade; by degrees she learned the names of colors and was able to distinguish them, though unable to interpret the chaos of color impressions she received. On the seventh day after the operation, she was seen to examine some tea cups and saucers. She thought them queer, but could not tell what they were till she touched them. Similarly she saw but failed to recognize an orange. On the eighteenth day, a key and a pencil case, with which she was perfectly familiar by touch, were placed side by side on a table before her: she could not tell which was the pencil case, which the key. At the end of three weeks, she saw a grassplot simply as a large and beautiful patch of green in her field of vision. How far it might be from her she had no idea. Usually in cases of this sort, the patient imagines at first that all that he sees touches his eyes, just as objects felt touch the skin.

On the twenty-fifth day, Wardrop's patient was taken out in a carriage, and inquired continually as to the meanings of her visual sensations. A person on horseback was vaguely a large object. She asked: What is that? of a soldier; and of some ladies wearing red shawls she inquired: "What is that on the pavement, red?"

At the end of six weeks it was found that she had acquired a pretty accurate knowledge of colors and their shades and names, but was unable to judge of distances or of forms, and the sight of all new objects was still very confusing. Neither was she able, without considerable difficulty and numerous fruitless trials, to direct her eyes to any object: when she attempted to look at anything, she turned her head in various directions until her eye caught the object she was in search of.

That our power of "seeing" solids is also extravisual was clearly shown in the case of Franz's patient. Among the observations reported of this patient, the following applies here: A solid cube and a sphere, each of four inches diameter, were placed before him, three feet off and at the level of his eye. After attentively examining these bodies, he said he saw a quadrangular and a circular figure, and after some consideration he pronounced the one a square and the other a disk. His eye was then closed, the cube taken away, and a disk put in its place. On opening his eye, he observed no difference in these objects, but regarded them both as disks. The cube was now placed in a somewhat oblique position before the eye, and close beside it a figure cut out of pasteboard, representing a plain outline prospect of the cube when in this position: both objects he took to be somewhat like a flat quadrate. A pyramid placed before him, with one of its sides turned toward his eye, he saw as a plain triangle. Placed so as to present two of its sides to view, the pyramid was a puzzle. After considering it a long time, he said it was a very extraordinary figure. It was neither a triangle nor a quadrangle, nor a circle; he had no idea of it and could not describe it. When he took the sphere, cube, and pyramid into his hand, he was astonished that he had not recognized them as such by sight, being well acquainted with them by touch.

What these patients had to learn in later life, more fortunate individuals born with unclouded eyes learn in infancy, but so forget the process that the acquirement seems to be innate, a simple function of the unaided eye. The mechanism involved in the process is described in every good treatise on human physiology: the metaphysics of the case are cleverly discussed in Taine's treatise "On Intelligence." Those of our readers who have taken issue with our remarks with reference to sight will find both aspects of the subject well worth pursuing in those works, to greater length than is possible in our limited space. The facts given are sufficient to sustain the position taken by us on this point in previous articles.

SOME NEW VOLCANO REVELATIONS.

The theory that our earth was successively a vaporous, a fluid, and a plastic mass, which, by cooling during billions of centuries, finally obtained a solid crust, in connection with the fact that during all this time she rotated round the sun and received on her equator solar heat (of which the poles were nearly deprived), leads necessarily to the conclusion that, in the neighborhood of the poles, the slowly forming solid crust must have become thicker than it is around the equator, because the solar heat was able to retard this cooling longer at the equator than at the poles. Such a crust is of course more easily perforated, by interior pressure acting outwardly, where it is thinnest; and volcanoes, which are the result of such perforation, must therefore be more numerous in the thinner places, such as around the equator, and scarce near the poles. This is confirmed by observation. Active volcanoes are not frequent around the poles; the only one near the north pole is in Iceland, while between the tropics such volcanoes are found in considerable numbers.

Another interesting consideration is that the amount of material ejected by volcanoes is enormous. The estimates as to the volume of the lava ejected by Vesuvius, Etna, and especially by the volcanoes of Iceland are appalling figures; and all these masses necessarily come from the interior of the earth, and must create in the neighborhood of the volcanoes (which may be considered as safety valves) empty spaces, which are filled up by a sinking of the crust. This logical conclusion has been verified by the observation that every active volcano is situated in the center of a region of depression, and never in one of upheaval, unless the material ejected by the volcano itself be so considered.

But a still more remarkable fact has been revealed by the calculations of astronomers making observations at different points of the earth's surface. It is that there are two points of depression, extending even over the ocean's surface, forming a kind of flattened poles, one the exact antipodes of the other. These points are the Antilles, in the West Indies, and the Sunda Islands (Java and its surroundings), in the East Indian Ocean. Each region contains a greater number of active volcanoes in a smaller surface than can probably be found anywhere else on the earth. But the reason why the ocean's surface partakes of this depression, at these two volcanic centers, is as yet a problem. Modern observations have already proved many irregularities in the form of the ocean's mean level, making the ocean's surface to be far from a perfect spheroid. As this surface must, according to the laws of hydrostatics, be always at right angles to the direction of gravitation, it proves that, at various points of the earth's surface, the lines of gravitation do not pass through the same central point, even on places of the same latitude. As gravitation is a general property of matter, depending on its mass, it proves that the mass in the interior of the earth is not homogeneous nor of uniform density, and that it is unequally distributed. As the interior is liquid, this distribution may be affected by cosmic influences, as for instance the relative position of the moon and planets; and any change effected in this distribution may react on the direction of gravitation on the earth's surface, and so on the form of the ocean, and thus slowly produce changes in its level, which may, in some cases, cause an apparent rising or depression of the land.

PROGRESS OF RAPID CITY TRANSIT.

The new Commissioners of Rapid Transit in this city are daily holding their sessions, and day by day their perplexities increase, if the published newspaper reports of their proceedings are correct. They are unable to agree either upon the plan of construction or upon the proper route. The original assumption that the Commissioners were committed to the election of some form of cheap elevated railway resulted in the production of a multitude of plans of that order: and the promoters of some of these plans are backed by influence which is not without effect upon the minds of the Commissioners.

The indications at present are that, if any plan of rapid transit is adopted now, it will be one comprising some form of cheap elevated structure to meet an immediate want, with little reference to ultimate economy. Not what is really best and cheapest, but what is least expensive at first, seems likely to win. The question, therefore, is not so much which of the temporary devices to adopt, as where the road shall be put.

All but two of the plans for elevated roads, laid before the Commissioners, propose to take possession of the public streets. Their projectors are no doubt able to demonstrate to their own satisfaction that such an occupation of the sidewalk or the roadway would be of signal advantage to any street which should be chosen as the route of their road: but can the occupants and property owners of any street be made to believe it?

If we are to have an extension of elevated rapid transit, which now seems quite probable, the public ought to insist that the new roads be put where they will do least injury to property and business, that is, *between the streets*, not over them.

The worst fallacy connected with this whole matter is the assumption that economy dictates a temporary structure of small capacity—a cheap affair to meet a pressing present need. The city of New York is in its infancy. Much as it needs rapid transit, and scarce as money is now, the metropolis of the country cannot afford to begin ill-advisedly, however cheaply, in a matter which must largely determine its future prosperity and growth.

The example and experience of the great city of London would be a very safe one for New York to follow. Rapid transit is chiefly effected in London by underground railways, which ramify in all directions; but as they are placed below the level of the streets, out of sight, their operation disturbs no one, while their advantage to the public is so great that every year witnesses their extension.

Sir Edmund Watkin, a member of Parliament and President of the Metropolitan (London) Underground Railway, and of the London and Great Eastern Railway, is now in this country; and a few days ago, at the request of the New York Rapid Transit Commissioners, he addressed them, giving a number of interesting particulars concerning the present status and operation of the rapid transit railway system of London.

The London Underground Railroad Company, he said, already had about sixteen miles of road in operation, and in a few months they would have twenty miles of completed road. They were negotiating for a still further extension of their routes, and would in time burrow under the whole city of London. These roads had proved to be a greater convenience to the poorer classes than to wealthy persons. The average fare collected was five cents, and the rate per mile was reduced by a system of commutation to one penny. Last year these roads carried 70,000,000 passengers. Heavy

locomotives were used, and 1,000 trains per day, each having a carrying capacity for 1,000 persons, were run over them. The rate of speed was thirty miles per hour, or twenty miles including stoppages. The cost was $5,000,000 per mile, of which about four fifths was due to damages to real estate caused by cutting through blocks of buildings and tunneling under houses. In some places the roads ran under graveyards without disturbing the graves and the vaults above.

According to this statement, the cost of building and equipment of the London underground roads has been one million dollars per mile, and the expenses for right of way and land damages four millions dollars per mile. This enormous cost for land would be wholly saved in New York, because here the railway lines would be longitudinal with and run directly under the main streets, without invading private property. But in London, owing to the formation of the city, the underground roads pass athwart the streets and cut through private property in all directions. The citizens of London have ascertained by practical experience that the underground system is the best, have invested in it upwards of eighty millions of dollars, and are annually increasing the investment and extending the works.

Sir Edmund answered a large number of questions put to him by our Commissioners, and corrected several erroneous impressions prevalent here concerning the underground railways of London. He explained the construction of those railroads, and described at considerable length the difficulties encountered in building and running them. He said that 93 per cent of the passengers on the London underground roads traveled only short distances, and only 7 per cent of them were carried to the end of the various routes. This fact was regarded as very important, because it showed that, in selecting a plan of rapid transit, the convenience and facility of those who wish to ride for short distances only ought to be considered.

STEALING BRAINS.

Professor Weisbach, in the preface to the further edition of his "Treatise on Mechanics," makes the following remarks: "As I consider my reputation as an author of much more importance than any mere pecuniary advantage, it is always a pleasure to me to find my 'Mechanics' made use of in works of a similar character; but when writers avail themselves of it without the slightest acknowledgment, I can only appeal to the judgment of the public." What the distinguished author has so clearly laid down is generally recognized as a leading principle by writers and editors. Most writers, for example, are glad to have the widest publicity given to their productions, provided they receive credit for the same; and there are few reputable editors or publishers who neglect this courtesy in copying from books and other periodicals. Still more rarely do writers who are compelled from the nature of their subjects to draw material from all sources omit to state this fact, and give due credit to all from whom they derive information. Recently, however, a very flagrant instance of neglect of this most ordinary courtesy has come to our notice, in a work entitled "Handbook of Land and Marine Engines, by Stephen Roper, Engineer." No reference is made, in the preface of this book, to any authorities who have been consulted; and throughout the text, all credit for data and remarks is, with very few exceptions, omitted. Some illustrative examples are given below; and in every instance mentioned, for anything that the author says, it might fairly be inferred that the matter is original

1. On page 81 is a stroke table, which is an exact reproduction of the original calculated by Mr. Auchincloss, to be found in "Link and Valve Motions," page 59.

2. On page 39 is a table of the properties of saturated steam, which originally appeared in the eighth edition of the *Encyclopædia Britannica*, and was copied, with due credit, in Wilson's "Treatise on Steam Boilers," and possibly in other works.

3. On pages 82, 84, and 88 are three tables from "Link and Valve Motions," which were original with the author of that work.

4. On pages 197, 216, 219, 220, and 285 are statements, illustrations, and examples, which were originally given in the "Cadet Engineer," on pages 156, 133, 136, and 24, respectively,

5. On page 227, we recognize a remark in regard to practical men, which originally appeared in the SCIENTIFIC AMERICAN, page 17, volume XXX. Other quotations from the SCIENTIFIC AMERICAN occur as follows: Page 258, the opening remarks of an article on page 305 of our volume XXXII; page 279, the entire article on "The Measurement of a Screw Propeller," which was published for the first time on page 240 of our volume XXXI; page 473, table and example from an article on "Feed Water Heaters," published on page 288 of our volume XXXI.

These are a few of the instances which we have marked. We could fill several columns with similar illustrations; but those already given, selected at random through the book, tell the whole story. In fact, we have never seen a more decided case of wholesale plagiarism, if we except an incident which occurred in our younger days, when the dullest boy in school mounted the platform and attempted to pass off one of Lord Bacon's most profound dissertations as an essay of his own composition. Happily, such instances of literary robbery are very rare, and we are inclined to think that Mr. Roper has sinned rather through ignorance than design. If so, he can even yet make some amends, tardy though they be, by publishing a supplement to his work, in which due credit is given to all authorities which have been used. By doing this, he will both increase the value of his work, and the respect in which he will be held by his fellow men.

TRAUBE'S ARTIFICIAL CELLS.

In the early days of modern chemistry it used to be taught that the compounds produced under the influence of life were different in kind from those of the chemist's laboratory, and subject to different laws. A characteristic of "vitality," indeed, was thought to be its power to reverse or transcend the laws of "dead" matter, death being the surrender of the organism to the forces of inorganic chemistry. It was commonly and confidently predicted that the chemist, however skillful, would never be able to construct the magic compounds formed by the creative power of life: it was even declared impious to attempt it. But chemists were not to be deterred by such objections. They persevered. They built up from inorganic materials first one, then another, then thousands of the so-called organic compounds, and the old theory of vitality was for ever shelved.

A corresponding mechanical theory of life is still held by most physiologists. The mechanism of organic growth is declared to be something quite unlike anything that occurs in the domain of lifeless matter, something utterly beyond the skill and power of man to imitate. Even the lowest of organized structures, it is said, exhibits a power of choice in the selection of food, and an individual mode of development, which combinations of inert matter can never rival. Life is assumed to be something unique, something superior to the crude forces of dead matter; hence the structural forms built up through its agency must be unique; hence it is impossible for man to produce anything like them. The whole chain hangs upon the first assumption, for which proof is lacking.

Seeing that the physiology of growth hinges on the life history of the cell—all organized bodies consisting simply of a more or less simple aggregation of these organic elements—the success which Traube has had in imitating with dead matter the characteristics of living cells shows that it is altogether too early to dogmatize touching man's present or future inability to rival the physics as he has the chemistry of life.

The behavior of those groups of compounds denominated colloids and crystalloids by Graham, when their solutions are separated by thin membranes from each other or from solutions of crystalline substances, needs no description here. The established fact that dissolved colloids cannot pass through colloidal membranes formed the starting point of Traube's investigations. He was aware of the additional fact that the precipitates of colloidal substances are themselves usually colloidal. It followed, as a natural consequence, that a drop of one colloid, if placed in the solution of another suitable colloid, would be converted into a closed cell by the precipitate formed by the mutual action of the two colloids at their surface of meeting. For example, a drop of concentrated solution of gelatin plunged into a solution of tannic acid is immediately surrounded by a pellicle of gelatin tannate, the thickness of which depends upon the relative densities of the two solutions. This colloidal pellicle is impervious to the colloid solutions, while it allows water to pass through freely. Hereupon most significant phenomena arise. The gelatin within the cell is more concentrated than the solution of tannic acid in which it is immersed; it has in consequence a stronger attraction for water, and absorbs a portion from the weaker solution. To make room for the increased contents of the cell, the pellicle stretches, separating its molecules to such an extent that the outer and inner solutions come in contact, and a fresh precipitate of gelatin tannate is formed between the original molecules. Through the enlarged pellicle, water continues to penetrate, and the process of growth in the cell wall goes on so long as a difference in density exists between the contents of the cell and the surrounding liquid. A firmer pellicle is formed when a little lead acetate or copper sulphate is added to the gelatin. That the growth observed is not a mere stretching of the pellicle occasioned by endosmose is proved by replacing the outside solution by water, whereupon the growth ceases, the formation of new molecules of precipitate being prevented. It will be remembered that the natural growth of living cell walls is by the same process of intussception, or the deposition of new matter between the molecules already existing.

While the cell wall is growing, changes also go on in the interior. So long as a nucleus of undissolved gelatin remains, the artificial cell is spherical. When the enclosed gelatin is all dissolved, the contents become diluted by the inflowing water, the density being least at the top, the heavier solution settling to the bottom of the cell. When sufficiently dilute, the cell contents begin to dissolve the cell-wall at the top; the pellicle of that part becomes thinner and more extensible; as it yields, new matter is precipitated between its molecules; in short the cell grows upward, and often protuberances directed outward are formed, in imitation of living cell growth. Still more remarkable is the behavior of the pellicle of copper ferrocyanide precipitated round a drop of a concentrated solution of copper chloride in a solution of potassium ferrocyanide: or, better yet, according to Sachs, around a small piece of solid copper chloride in the ferrocyanide solution. In the latter case a green drop is immediately formed at the expense of the solution, the precipitated pellicle of which encloses the solid nucleus which is gradually dissolved by the permeating water. Cells so formed manifest active growth and a variety of differences not easy to explain. Some have very thin pellicles, are roundish, and exhibit a slight tendency to grow upward; they usually form a number of small wart-like outgrowths, and attain very considerable dimensions—from 0·4 to 0·8 of an inch in diameter. Others have thick reddish brown pellicles, grow quickly upwards in the form of irregular cylinders, rarely branch, and attain a diameter of from 0·08 to 0·16 of an inch, and often several times that measurement in hight. Sometimes combinations of these two kinds form a sort of horizontal tuberous rhizome-like structure, from which long stalk-like outgrowths arise upward and root-like protuberances downward.

Sachs insists that these pellicles of copper ferrocyanide do not always grow entirely by intussception, as Traube supposed, but sometimes by eruption, as he terms it. In such cases a brown pellicle is formed round the green drop; water penetrates quickly through the pellicle to the enclosed copper chloride, stretches the pellicle rapidly, and at length ruptures it. The green solution immediately escapes through the fissure, but becomes at once coated with precipitate which appears either as an intercalated piece of the previous pellicle, or as an excrescence or branch of it, a process which is repeated as long as any copper chloride remains inside the cell. Besides these solutions already named, Traube experimented also with mixtures of tannic acid with copper and lead acetates, and soluble glass with the same substances, or with copper chloride, etc., and came to the conclusion that every precipitate, the molecular interstices of which are smaller than the molecules of its components, must assume the form of a pellicle when the solutions of its components come in contact.

These pellicle precipitates are peculiarly well adapted for the study of endosmotic processes. They behave very differently from other membranes, being often impermeable to the most diffusible substances, while allowing other compounds to pass through them; and every kind of pellicle has in this respect its own peculiarities. For instance, the gelatin tannate employed by Traube in most of his experiments is impermeable to potassium ferrocyanide but permeable to ammonium chloride and barium nitrate. The pellicle of copper ferrocyanide of the other experiments mentioned is impermeable to barium chloride, calcium chloride, potassium sulphate, and barium nitrate, but permeable to potassium chloride. Again, if a small quantity of ammonium sulphate is added to the solution of gelatin, and a small quantity of barium chloride to the tannic acid, the pellicle formed by their admixture is composed of calcium tannate with barium sulphate deposited upon it, diminishing its permeability: the two solutions can no longer diffuse, but the encrusted pellicle is still permeable to the smaller molecules of ammonium chloride and water. From facts of this sort Traube infers that, in the permeability of pellicle precipitates, we have a means of determining the size of the molecules of different solutions, since only those molecules can pass through a pellicle which are smaller than its molecular interstices, and therefore smaller than the molecules of the solutions which produce the pellicle.

SCIENTIFIC AND PRACTICAL INFORMATION.

OXUVITIC ACID.

MM. A. Oppenheim and S. Pfaff announce the discovery of a new acid named as above, and having the formula $C_6 H_2 (CH_3, OH, COOH, COOH)$. It results from the action of chloroform on acetic sodic ether.

MANUFACTURE OF ARTIFICIAL ALIZARIN.

The process of manufacture of this substance, as practised in Frankfort, Germany, consists in heating for 8 hours, in earthen vessels, anthracene having its fusing point between 404° and 410° Fah. with one fourth its weight of bichromate of potash and 12 parts nitric acid of a density of 15·04. Anthraquinone is thus formed, and the crude resulting product is dissolved in 6 parts boiling nitric acid, of density 1·5. The dissolving of the anthraquinone is continued until, on cooling, no residue of that substance is precipitated. The solution then contains anthraquinone in a mononitrated state, which is precipitated by water; and on the solution becoming clear, the precipitate is dissolved in from 9 to 12 parts of a solution of caustic soda of specific weight 1·3 to 1·4, heated to about 382° Fah. When the precipitate is no longer augmented by the addition of hydrochloric acid, the heating is arrested. The mass is allowed to cool, dissolved in boiling water, and filtered, and the coloring matter precipitated in the hot solution by means of an acid. The yellow brown deposit is then ready, after washing, to be used for dyeing. The residue on the filter is principally anthraquinone, which is re-used. The manufacture of artificial alizarin is constantly increasing. The German production is estimated at some 1,198,000 lbs. per year.

NEW METHOD OF DETECTING ADULTERATION OF FATTY OILS.

M. Roth employs, as a re-agent for the above, sulphuric acid at 46° B. saturated with nitrous vapors by causing nitric acid to act upon large pieces of iron. At the end of six or eight days, the solution acquires a fine bluish green color, indicative of complete saturation. This re-agent solidifies either partially or entirely the olein of non-siccative oils. The purity of the oil may thus be determined by noting the time which it occupies in solidifying.

DETECTION OF PICRIC ACID IN BEER.

For this purpose, Brunner recommends acidulating the beer with hydrochloric acid, and plunging therein a fragment of woolen thread, and digesting the same in a *bain marie*. After the thread is removed, it is heated with a solution of ammonia. The latter is filtered, evaporated in a *bain marie* to small volume, and a few drops of cyanide of potassium are added. The presence of 0·015 grain of picric acid in a pint of beer is determined by a red color being produced, due to the formation of isopurpurate of potash.

FLOATING FIRE ENGINES.

The use of floating fire engines is rapidly extending in all commercial cities, where wealth, in buildings and merchandise, is always aggregated on the banks of the rivers, readily accessible to vessels, and with an unlimited supply of water at hand. Some improvements in these engines have recently been effected by Messrs. Merryweather and Sons, of London, England, and three of them, of the most powerful construction, have been supplied to the French Government. The long lines of shipping which bound this city, and the dangers of fire to which, from many causes, it is exposed, give especial interest to these useful machines at the present time.

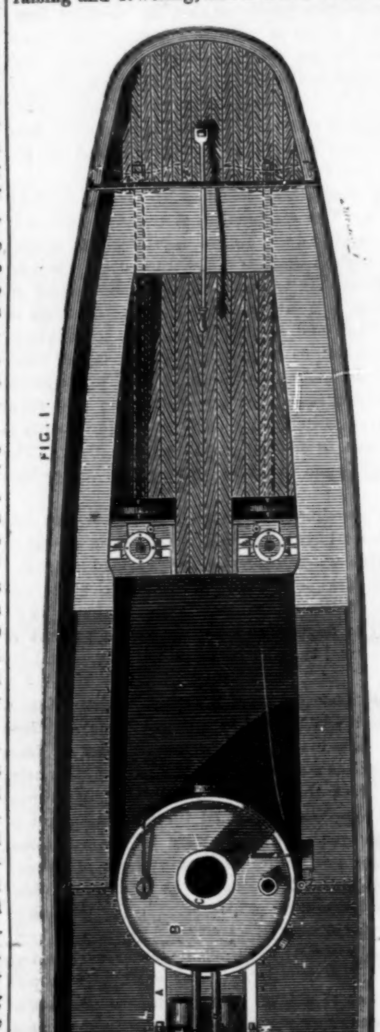
On the trial trip of one of the engines, which is now on duty at Marseilles, France, the little vessel, full of passengers, left the pier at Charing Cross and steamed with the tide to Battersea bridge, which she reached in twenty minutes. She steamed a short distance beyond the bridge, and was then turned, running back against tide, and reaching the Charing Cross pier in 56 minutes from the time of starting. On her way back she was stopped at Millbank and successfully beached; the object of the manœuver was to show that she could approach inshore sufficiently close to enable men to convey hose on to land without having to pass through deep water. The total distance run by the float—in and out—was three miles and two thirds, the time occupied being 56 minutes, including the stoppage for the beaching operation. On her way up the river, time was taken between the Chelsea suspension bridge and the Cadogan pier, a distance of exactly three quarters of a mile. The time was exactly 4 minutes, giving a speed of about 12 miles an hour with tide, the time on the return against tide between the same points being 7 minutes, or at the rate of about 6 miles an hour. During a portion of the distance only one engine was at work, besides which she had a number of passengers on board, so that the average speed of about 9 miles an hour which she attained was a very successful result. On reaching Charing Cross pier, the pumping engines were set to work and a fine jet was thrown from a 1¾ inch nozzle to an estimated hight of 180 feet. Two jets were then played from 1¼ inch nozzles and afterwards four jets from 1 inch nozzles to an estimated hight of 160 feet. The whole performance was in every way satisfactory.

Turning now to Figs. 1 and 2, it will be seen that the vessel is a neat boat 45 feet in length, 8 feet beam, with 2 feet draft forward, and 2 feet 10 inches aft, and having a total depth of 4 feet 6 inches. Her builders were in some measure restricted as to the dimensions of the boat, as a vessel of larger dimensions cannot be conveniently loaded on shipboard in one piece for transport. The boat, however, is not cramped, as there is ample room for coals, hose, stores, and cabin compartment. The propelling engines are two in number, each working a gun metal screw 28 inches diameter. The cylinders of those engines are each 5¼ inches in diameter, with a 6 inch stroke, the number of revolutions being 280 per minute, and the steam pressure 75 lbs. per square inch. These engines work independently of each other, in order to facilitate the manœuvering of the float, which will have to run in and out among shipping; and during the recent trials on the Thames it was jocosely called the blockade runner. By adopting twin screws the vessel is able to travel in shallow water, a very desirable feature in running up creeks. The boiler is on the Field principle, and is arranged to drive the propelling engines and steam fire engine simultaneously, if required, and this would happen in the case of a fire among shipping, wherein this engine might not only have to be engaged in towing out a burning vessel, but in pumping upon her at the same time. The boiler has a large water and steam space; and considering the quantity of water it has to convert into steam at 75 lbs. pressure, and notwithstanding the large cubic contents to be filled by steam before reaching that pressure, it effects this object in the very short time of 10 minutes. The boiler contains 426 Field tubes, giving 236 square feet of tube surface, and 35¼ square feet of fire box surface, and is mounted with the usual fittings, having one pressure gage for the stoker and another for the engine driver, a spring safety valve and another on an improved principle, gage cocks, whistle, etc. It is fed by feed pumps attached to each propelling engine, by another long stroke feed pump on the fire engine, also by an arrangement by which the whole supply of the fire engine pumps (11·6 gallons) can be forced direct into the boiler by one stroke, and, lastly, by a Giffard's injector.

The steam fire engine, while limited in weight and space, is simple, and of sufficient strength to stand the rough usage to which such machines are usually subjected. The pumps have a steady stroke of 24 inches. There is no dead point in the course of the pistons, and the engine will start with the latter at any position in their stroke as soon as steam is turned on. Another advantage is that the engine can be worked at full speed, or at any intermediate speed, in the event of a limited supply of water, or as slow as one or two strokes per minute. This enables the attendant, in case of need, to pump direct from the main pumps into the boiler—a feature peculiar to these engines, and of great value when, by neglect, the water is short in the boiler, or for the purpose of lowering the pressure of steam on suddenly stopping the engine. The pump is arranged to throw any class of water, whether it be muddy or floating with sea weed, shavings, etc., the valves being specially adapted for such purpose—an important feature.

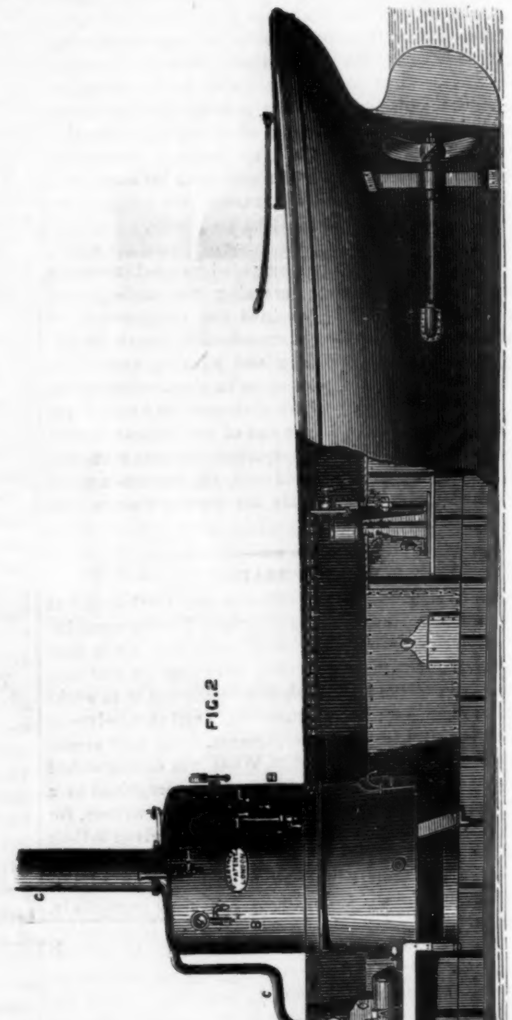
Our engravings represent general and detail views of the float and its engines, Figs. 3 and 4 being respectively a plan and a sectional elevation of the vessel, and Figs. 1 and 2 a plan and elevation of the pumping engine. In these views, A is the framing, forming the bedplate of the engine. The frames are supported on a series of bearers fixed in the boat, and are also connected with the boiler, thus forming one rigid structure, and which does not exhibit any vibration of the vessel, when all the machinery is in full operation. B is the boiler, constructed on the Field system; the tube and top plates are of the best boiler iron, the shell of steel five sixteenths of an inch thick. The top and tube plates are fitted with eight screwed stays; the top plate has four hand holes, and the water casing around the fire box has six mud holes, and blow-off cocks. The chimney, C, is hinged for raising and lowering, and is fitted with counterbalance and

FIG. 1



MERRYWEATHER'S FLOATING FIRE ENGINE—PLAN OF VESSEL

FIG. 2

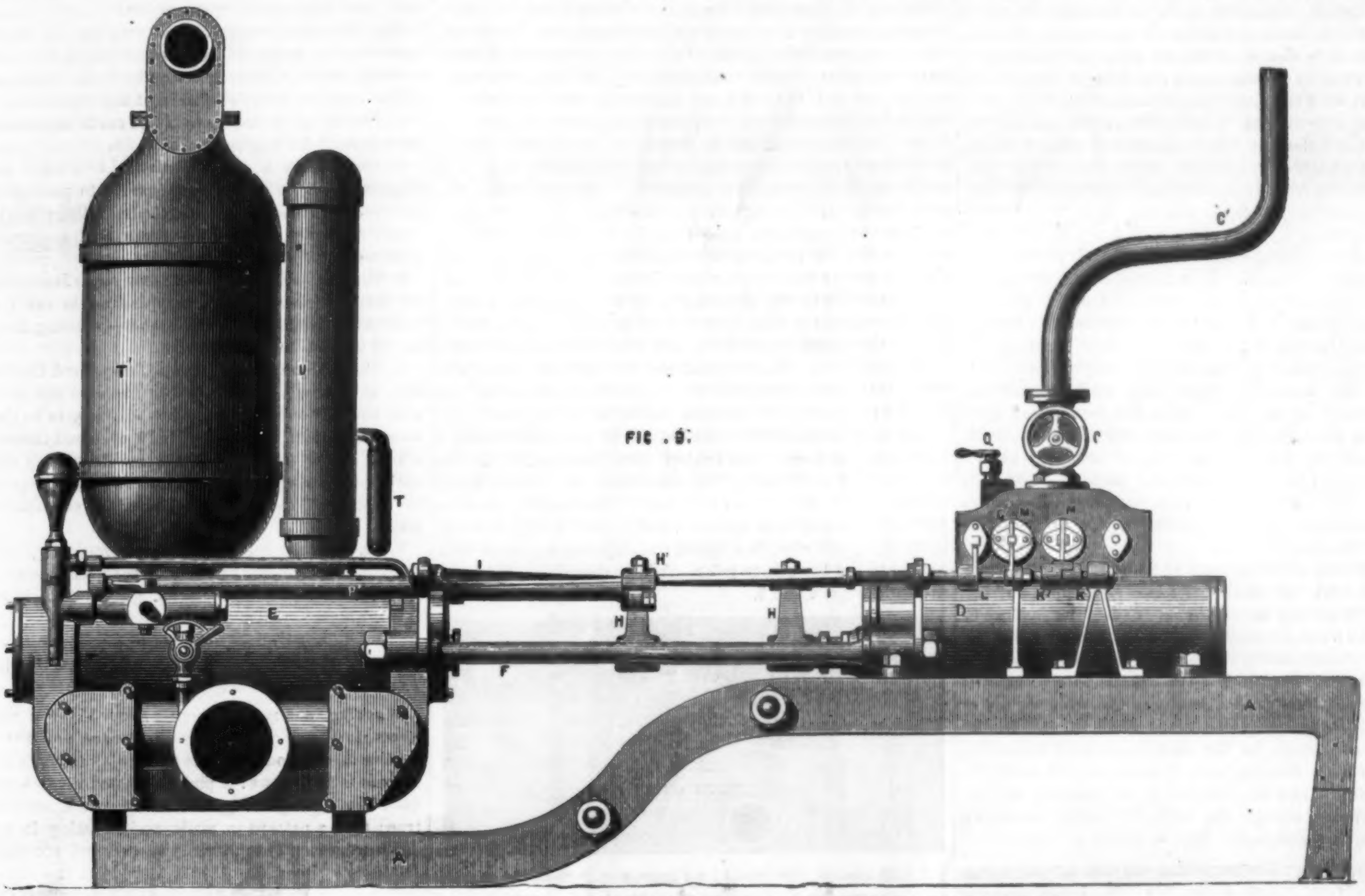


MERRYWEATHER'S FLOATING FIRE ENGINE—ELEVATION OF VESSEL.

chain. The steam cylinders, D, are each 8¾ inches diameter and 24 inch stroke, and are cast in one piece. They are fitted with wrought iron covers and gun metal glands, and are fixed to the frames by strong brackets and bolts. E is the main pump, which consists of one solid gun metal casing, formed in such a manner that the barrels are not cut or cored when pumping sandy water, and having the valves so constructed that any grit drawn into the pump does not pass into the pump barrels, but is discharged at the next stroke through the delivery valves. These valves are placed in the lowest part of the valve chamber, instead of in the highest part, as is usual in most pumps; and as all water runs freely out of the pump when at rest, the latter are not liable to be disabled by frost. The valve openings are large and quite free, having no gratings to impede the passage of solid materials, while the valves and seats are readily removed for inspection or repairs. The pump pistons are self-lubricating, and when at work never require the application of the oil can. F F are wrought iron stays, coupling the steam cylinders direct to the pump in a rigid manner, thus relieving the frames of all strains during pumping. The piston rods, G, connect the steam pistons with the pump pistons, and are formed of solid steel throughout without a joint. The crossheads, H, are keyed on the piston rods, and carry gun metal clip brasses, H', which slide along, and give a partial revolution to the motion bars, I, and these bars actuate the valve levers. The main piston slide levers, K, fit easily on the motion bars, and are actuated by the tappet clutches, K'. Levers, L, are fixed to the motion bars, I, for moving the small leading piston slides, L'. The starting levers are seen at M, and at N are the main piston equilibrium slide valves for reversing the flow of steam into the cylinders, these slides

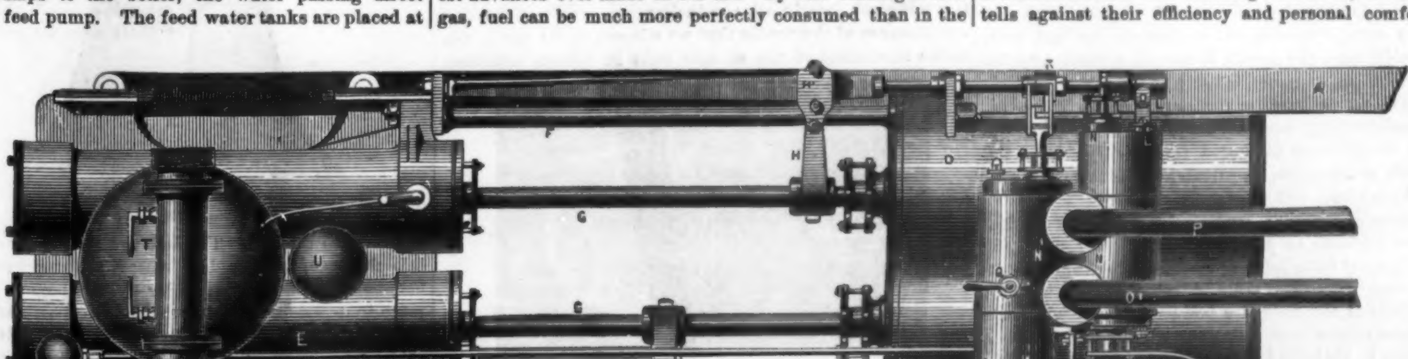
being so constructed that, when they are in the middle of their stroke, the steam ports are quite closed, preventing the inlet of more steam, and the exit of the exhaust steam, and thus bringing the steam and pump pistons to rest. At one end of each of the piston slide rods, N', is attached a small piston working in a cylinder, to which steam is admitted by the leading piston valves, L'. The power used to move the slide is merely nominal, not throwing the least strain on the motion bars, I, and as a proof of this a slide can be pushed, arrested, or forced forward by hand while the engine is working.

O is the starting steam valve in the steam pipe, O'. The



MERRYWEATHER'S STEAM FIRE ENGINE—ELEVATION.

exhaust pipe, P, passes down the chimney into a hollow baffle, having an aperture upwards, through which the exhaust steam passes into the chimney, affording the necessary blast. Q is a small steam valve for admitting steam to the small cylinders, Q'. The feed pump, R, is easily accessible. There is a pipe from this feed pump to the fresh water tanks. The plunger is of steel, and covered with brass, the diameter being 1 inch and the stroke 24 inches. The plunger is fixed to the crosshead, H, on the driving side. S is a check valve in the feed pump pipe to the boiler. T is a patent air vessel automaton feed apparatus for keeping up the required amount of air in the air vessel, T', to insure a steady jet of water at the nozzle. U is the suction air vessel, and V a pipe from the main pumps to the boiler, the water passing direct through the feed pump. The feed water tanks are placed at



MERRYWEATHER'S STEAM FIRE ENGINE—PLAN.

each side of the fire engine under the deck; there is also another tank immediately under the engine. The coal bunkers extend along each side of the boiler, as far back as the propelling engines; there is therefore an ample supply of fresh water, and a large capacity for carrying coals.

The pumping power of this little float is very great, being 1 000 gallons per minute through a jet 1¼ inches in diameter to a hight of 212 feet. It is arranged to pump 4 jets, and these, each 1 inch diameter, can be thrown to a distance of 200 feet.

BUTTER is said to be a very sensitive reagent to reveal the presence of copper.

Economy in the Use of Fuel.

In a paper on economy in the use of coal, lately read before the Royal School of Mines, Berlin, the following synopsis of interesting historic facts is given: The progress in the economical consumption of fuel in the last 50 years has been enormous, and has been effected in great part by metallurgists; and here again we find the scientific men taking the lead. In the economical application of the heat developed by fuel, the Bessemer process is enormously effective, not more than 10 lbs. of coal being requisite for the production of 1 cwt. of steel from pig iron by this method, while in the older process, still in use for fine qualities of steel, 250 lbs. are needed. Siemens, by making the heat which would escape through the chimney of an ordinary furnace warm the fuel and the air necessary to combustion, obtains an economy of two thirds the weight of fuel. It was Faber de Faure, an accomplished Bavarian metallurgist, who first made practical use of the gases which formerly escaped in immense quantities from the tops of blast furnaces; and the enormous blast engines, the hoisting engines, pumps, and hot blast stoves, even the roasting kilns of such establishments now-a-days require no fuel except this long neglected waste product. Bischof, another German engineer and metallurgical author, was the first to produce gas artificially for smelting purposes, and this was certainly one of the greatest advances ever made in our art. By first turning it into gas, fuel can be much more perfectly consumed than in the solid form, and hence can be made to give us, as in the Siemens furnace, in which only gas is used, a much higher temperature than is practically attained by the combustion of coal in the ordinary way; but perhaps the greatest advantage of gas is that substances, in general scarcely regarded as fuel at all, can be employed for the production of gas with the most brilliant results, a matter of the greatest importance, especially in a region destitute of true coal like California. Lundin, a noted and thoroughly educated Swedish metallurgist, has taught us how to produce gas from wet sawdust, entirely without preparation, of such power that wrought iron may be melted with it, and the great difficulty is to find any material infusible enough to answer as a lining in the furnace where it is consumed. Some idea of the importance of these improvements will be had from the fact that the economy in fuel effected in England alone, in the year 1872, as compared with 1871, by the progress made in the introduction of more perfect apparatus, represented more than 4,000,000 tuns of coal.

Heavy vs. Light Tools.

The great end at which all improvements aim is the maximum of power combined with the minimum of material and weight. A man shoveling dirt with a shovel one pound heavier than it should be will lift 6,000 pounds more in a day of ten hours than he would do with a suitable shovel All this strength is wasted.

The same is true of machinery. So simple a thing as an unlubricated pulley is felt in the furnace, and the cost of the coal is augmented. Every useless pound in a truck or carriage takes vitality from the horse which draws it, and costs the owner many extra dollars for his keeping. The man who pulls an oar in the great boat races at Saratoga puts himself in training and reduces every ounce of surplus flesh. The racing horse carries not one extra ounce of fat to burden him in the effort to win. Yet working men will carry through half their lives fifty pounds more flesh than is needed for the best working condition, a burden which tells against their efficiency and personal comfort through many years of their industrial life. These may seem little things; but whatever wastes power, increases expenses, and burdens the laborer is not a little thing.

THE new direct Atlantic telegraph cable has been successfully laid, and messages have been transmitted at a high rate of speed between New York and London. But the ice bergs have, it is supposed, injured the cable, and the contractors are now fishing up and cutting out the fault.

THERE are twenty-three miles' length of pneumatic tubes now in operation in London, used for sending telegraph messages.

Correspondence.

Terrestrial Magnetism.

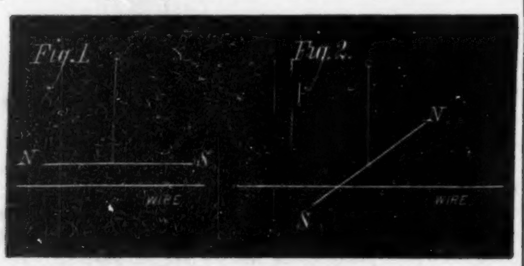
To the Editor of the Scientific American:

In your issue of August 14 appeared an interesting article on the subject of terrestrial magnetism, so-called, in which the views entertained by Humboldt, Hansteen, and Gauss were clearly outlined. During the past year, I have devoted considerable attention to the phenomena of the earth's electricity, and my experiments have demonstrated that there is no such thing as terrestrial magnetism in the sense in which the term is usually employed. To use the term terrestrial magnetism is to indicate that the earth is a magnet, whereas the force which is characterized as terrestrial magnetism stands, with relation to magnetism, precisely as the galvanic current stands with relation to an electromagnet.

I began my experiments in full view of the phenomena set forth in the article to which allusion has been made, namely: The observed declination of the magnetic needle, and its inclination, and the intensity of its action, as well as the facts that these phenomena not only vary in one place from another, but in the same place with time, and that the needle is subject to disturbances from natural phenomena, such as the aurora borealis. I had, in addition, the important premise that currents of electricity are continuously flowing round the earth (I use the expressions "currents" and "flowing" merely as convenient terms), as is every day demonstrated in lines of telegraph connecting with the earth and without the battery.* That these earth currents are mainly generated by the sun's light and heat falling upon the surface of the earth, there cannot be the slightest doubt. That the electricity thus generated is of two well known forms, thermic and frictional, there also can be no doubt; nor would it be difficult to estimate the immense volumes on electricity generated in a day by the impact of the light waves upon the earth's surface.

With these acknowledged facts and observed phenomena, in connection with the results of some experiments of my own, it became an easy matter to show that the surface of the earth is an immense electric helix, or a series of sections of helices or electric belts, whose right angles are the poles.

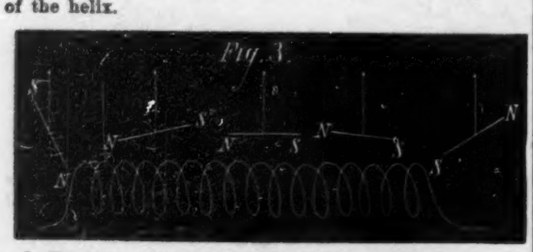
Taking as a basis the two facts that earth belts of electricity exist, and that their direction is east and west, we are at once brought face to face with the phenomena of deflection of a magnetized needle by the electric current, discovered by Œrsted in 1819, namely, that, if a magnetized needle be suspended parallel to a wire conductor, the moment an electric current is sent through the wire the needle assumes a position at right angles to the wire, or nearly so, thus:



In Fig. 1 is seen the suspended magnetized needle with its poles parallel to the wire. In Fig. 2 is seen the result when a current of electricity is sent through the wire. And here we have in miniature the cause of the direction of the compass needle. The wire in Fig. 2 represents the earth currents flowing east and west; and, as in this experiment, the compass needle is beyond doubt caused to point north and south by the earth currents, which, flowing east and west, must inevitably cause the needle to assume a right angular direction, which, as we know, is north and south.

But we have not yet made sufficient progress. We have, it is true, satisfactorily accounted for the direction of the needle, but we have not accounted for the dipping of the needle, which, at the poles, is equivalent to its assuming a direct vertical position. Let us examine further.

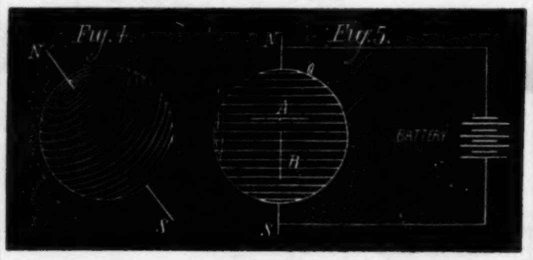
As the electric belts, surrounding the earth, and moving east and west (at least as rapidly as the diurnal revolution of the earth), must form belts or circles of less and less diameter as we approach the poles, so at the poles we must have the effects of the ends of a helix or coil of wire; and what are these effects from a helix in which the electric current is flowing? Perhaps I cannot better answer and illustrate than by a diagram of a helix with a compass needle suspended in various positions with respect to the longitude of the helix.



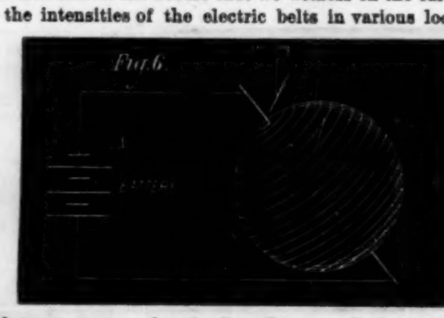
In Fig. 3 it will be observed that, at the longitudinal center of the helix, corresponding to the earth's equator, the needle, being equally affected by both terminals of the helix, preserves a horizontal position, but that, as we approach the terminals, the needle dips and finally inclines to enter the helix. In this simple form we have all the phenomena of the direction and dip of the compass needle, the electric current, flowing in the coils of the helix at right angles to the needle, corresponding exactly with the electric belts encircling the earth, which flow at right angles to the needle and produce precisely the same results.

The effects of the currents flowing in a helix, it is thus seen, are in every way the same as the effects of the electric currents encircling the earth east and west. The theory that the phenomena of the magnetic needle are due to the existence in the earth of a great magnet or a series of magnets, is not only utterly improbable, in view of the phenomena observed, as it renders the phenomena impossible: but it is utterly and wholly superfluous, since we have in the electric earth belts ample force, and a force which we know could not possibly fail to produce the phenomena. Deschanel, one of the greatest of practical students of natural philosophy, well says: "The actual phenomena of terrestrial magnetism are not in very close agreement with the results which would follow from the presence of such a magnet * * in the earth's interior, nor do they agree well with the hypothesis of two interior magnets inclined at an angle to each other, which has also been proposed. It would rather appear that the earth's magnetism is distributed in a manner not reducible to any simple expression." Thus the problem is abandoned in the glamour of an hypothetical terrestrial magnetism; yet the same author gives a diagram of the lines of equal intensity in the phenomena of the magnetic needle, and these lines are from east to west, precisely as the direction of the electric earth belts, and are closely allied to the isothermal lines. The thermal electric belts encircling the earth, it became apparent to me, must correspond to the isothermal lines, and this has been shown to be the case.

Although satisfied with the results of my experiments, I determined to pursue the subject more thoroughly, for the purpose of demonstrating the correctness of my deductions beyond the shadow of a doubt, and I constructed a wooden globe sixteen inches in diameter, and wound it with a single layer of copper wire, in a spiral running east and west with respect to the imaginary poles. When completed, it was as shown in Figs. 4 and 5.



I then placed a suspended compass needle near the surface of the globe, so that, when no current was traversing the lines, the needle stood in the position shown at A. The instant the battery was applied, however, so as to give the electricity the direction of the earth's belts or currents, the needle assumed the position shown at B, pointing to the north and south poles of our miniature world. Thus in our great world, as in this miniature world, the earth's electric currents, moving in the direction of east and west, deflect the magnetic needle to right angles, so that it points north and south. By varying the strength of the current from the battery, by changing the position of the needle with respect to the north and south poles, and by so connecting the battery with different parts of the helix surrounding the miniature globe as to preserve the isothermal lines of force, so as, in a word, to imitate all the varying strengths and disturbances of the earth's electric currents, I was charmed to witness in the minutest details all the inclinations, declinations, and disturbances of the needle that we witness on the earth, due to the intensities of the electric belts in various localities,



and to numerous electric disturbances. Perhaps I cannot show more clearly than by a quotation, not only the fact that the phenomena of the magnetic needle are due to the electric earth belts, but that these electric belts are continuous, and in large part thermal and frictional, proceeding from the sun's heat and light:

"Besides the gradual changes which occur in terrestrial magnetism, both as regards direction and intensity of force, in the course of long periods of time, there are minute fluctuations continually traceable. To a certain extent, these are dependent on the varying position of the sun; but over and above all regular periodic changes, there is a large amount of irregular fluctuations which are invariably connected with exhibitions of aurora borealis. They are sensibly the same at stations many miles apart, and they affect the direction and amount of horizontal much more than of vertical force" in the magnetic needle.

As we approach the poles of our miniature globe with the needle, it gradually loses its horizontal direction, dipping downward, just as we observe when we approach the poles of the earth, until we reach one of the poles, when it becomes vertical and tends to plunge into, and to one side of, the helix, as indicated in Fig. 6.

The problem is clear enough when we recall to mind that as we travel northward upon the earth from the equatorial electric belt, the north pole of the needle inclines downward at the rate of about 1° for 1° of latitude, until we reach the north magnetic pole, latitude 70° 5′ N., longitude 96° 45′ W., at which point the needle points directly down to the earth.*

Of the many interesting details of the phenomena observed in my experiments, it is impossible to treat in the space of a single article. At some future time I hope to present the facts more in detail.

What we have learned and what we now know, so far as human knowledge based upon practical experiments can extend, may be summed up as follows:

That the earth is not a great magnet, but that the phenomena of the magnetic needle are due to the electric earth currents, which flow at right angles to the earth's axes.

These are, in brief, the bases of the argument:

1. No placing of magnets in the earth can account for the variations of the magnetic needle.

2. Even if, by a cumbersome and overdrawn hypothesis, magnets could be placed in the earth to produce the effects observed at different places, the variations would still be unaccounted for, for the reason that such magnets would be permanent and without fluctuation.

3. The magnetic theory is utterly superfluous, for the reason that the electric belts surrounding the earth, which we know exist, could not exist without causing the magnetic needle to point north and south.

4. These electric belts, being thermic and frictional, must vary in localities, and according to the situation of the sun with respect to the earth. This we know to be the case, for we not only find the thermic belts of equal intensity, as exhibited in the direction of the needle, closely allied to the isothermal lines, but we find that the needle's perturbations are dependent upon the situation of the sun and auroral displays.

5. The electric belts, not only theoretically, but by actual practical experiment, as we have seen, satisfactorily account for all the observed phenomena. W. E. SAWYER.

Washington, D. C.

Repairing the Independence Bell.

To the Editor of the Scientific American:

Working in a railroad repair shop, I saw a machinist fit pieces into broken locomotive cylinders, and the idea of repairing the bell on the same principle suggested itself. The process is as follows: A piece is slotted out by a machine (see dotted line in engraving) and the surface is scraped perfectly true; then a pattern is made, and a casting in bell metal is made from it. This piece is planed and scraped to fit perfectly into the slot. This is done with the same nicety as making a patch for a broken locomotive cylinder. To fasten it in its place, an oven is constructed with a door large enough to admit the bell. The bell will stand upside down, on an iron truck, with a wheel under it, so that it can be put in and taken out of the oven conveniently. The oven must be heated by a clear fire, free from smoke, and the flames are

not to touch the bell. The bell and the piece are to be put into the oven, and the door closed, till they become heated hot enough to melt silver solder. Then remove the bell and piece from the oven, and treat the sides of the crack and piece with muriatic acid, prepared as silversmith's acid for soldering. Then coat the sides of the crack and piece with silver solder. Do this part expeditiously, and free the surfaces from dross; then, while the bell is hot and the solder in a soft adhesive state, insert the piece in its place. Have at hand two large pieces of iron (shaped like the inside and outside of the bell), red hot, with suitable tongs for holding them. These are to be used to keep up the heat if necessity requires it. When the soldering is completed, allow the bell to cool off.

I do not propose that the bell be used very roughly when repaired by this process; but I have no doubt it would be a great pleasure for the people to hear the old bell peal forth with clear tone once more. CHARLES SMITH.

Ashley, Pa.

Ascertaining the Altitude of Clouds.

To the Editor of the Scientific American:

Your correspondent, C. G. Forshey, claims that, by a method which he relates, he has ascertained the altitude of some thunder or storm clouds to be as great as 13 miles.

For amusement, I have often computed the distance to

*In long ocean cables, these earth currents are so strong that they often seriously interfere with the working of the instruments.

* It will be noticed that, in the illustrations, I have merely indicated the electric poles, without reference to the axes of the earth, which are slightly different.

some object struck by lightning from a passing cloud, by applying the familiar laws which govern the speed of light and sound: and while thus engaged, I found that, by the application of the same laws, I could also determine, with nearly the same accuracy, the hight of the cloud whence the lightning proceeded.

When a flash is seen, it starts from different parts of a cloud, frequently from directly overhead; and after collecting its complement of volume and force (the work of an instant), it leaps to the earth from a quarter of the cloud often quite distant and unlooked for. Upon seeing a flash, starting, say, overhead, I begin counting seconds. After an interval, perhaps of 7 or 8 seconds, rumbling thunder is heard, first overhead, then in various portions of the cloud, differing in loudness according as the different initial forks of lightning differ in distance; then all following the wake of each electric chain, until, in 15 seconds, it concentrates in the final crash. Distance to the object struck, about $3\frac{1}{4}$ miles; hight of the cloud, about one mile and a half. When an object is struck close by, these sounds proceed in reversed order. The prolonged rumbling sounds, heard before and after a stroke of lightning, are not all reverberations, but are in great part true detonations of the electric fluid while it is gathering up from the different and very unequally distant quarters of the cloud, before its discharge to the ground.

By my method of computation I find storm and thunder clouds to range from two miles high down to the very ground. I submit my plan with the hope that it will be fairly tested. J. M. S.

Lynchburg, S. C.

The Keely Gas.

To the Editor of the Scientific American:

I notice, in an article headed "Gems from the Keely Motor," in your issue of July 24, the following statement: "It is a vapor of so fine a quality that it will penetrate metal, and is lighter than hydrogen." I contend that such a substance would be contrary to the laws of Nature.

It is well known that the molecules of all substances increase and decrease in size in proportion to the specific gravity of the substance, the lighter substance containing the larger molecules. This may be demonstrated by pouring as much water into a glass as it will hold, then taking a liquid of a heavier specific gravity than water, and adding a portion to the water in the glass We find that the quantity added before the glass overflows will be in proportion to the difference between the specific gravities of the two liquids. If you then repeat the experiment, but add a liquid lighter than water, you will find that the volume will be increased and the glass will overflow, the quantity overflowing being exactly the same in volume as that which you added. This is explained in the following way: On filling the glass with water, a portion only was filled, there being vacancies between each and every atom of water; on adding a heavier liquid, the atoms of said liquid, being smaller than the atoms of water, pass between them, filling up the vacancies; and until a sufficient quantity has been added to fill those spaces, it does not increase the volume of water; but on adding the lighter liquid, the atoms of which are larger than those of the water, they do not pass between them, but immediately increase the volume and overflow the glass.

If this be correct, and I have good reason to think it is, it at once proves the impossibility of such a substance as this so-called cold vapor is described to be; for it is plain that it would be impossible for the larger atoms or molecules of the cold vapor to pass between the smaller molecules of metal. Were the specific gravity of the cold vapor heavier than metal, instead of being lighter than the lightest known substance, it would be more practicable.

Monticello, Pa. E. G. ACHESON.

The Remarkable Electric Phenomenon.

To the Editor of the Scientific American:

Regarding the statements relating to the singular electric phenomena described on page 100 of your current volume, as being in some respects opposed to hitherto observed facts, I decided to investigate the case thoroughly, and ascertain in the first place what the facts were, and then see whether they were in accord with previous observations. For this purpose, I sent one of my assistants to the house where the electrical displays occurred, furnished with the proper instruments for making careful and accurate measurements of the resistances of the rods, pipes, and other conductors about the premises.

The first measurement taken was to ascertain the resistance between the two pipes leading to and from the heater. This was found to be less than 0·01 of an ohm, and most of that was probably due to the connections of the galvanometer. Of course this proved conclusively that no sparks ever passed between these pipes, and Mr. Baldwin, the occupant of the house, said that the published statement was wrong in this regard.

The resistances of the supply pipe, overflow pipe, waste pipe, and lightning rod were then measured, with the following results: Resistance of the lightning rod = 161 ohms; of waste pipe = 284 ohms; of overflow pipe = 15 ohms; of supply pipe = 0. The house stands on a hill on the dividing line of a slate and limestone formation, and the lightning rod has been placed in the fissure of the rock to the depth of perhaps 6 or 7 feet, and is therefore partially insulated; and its normal resistance is doubtless much more than 161 ohms, which was found while everything was wet, a rainstorm having come up just before the tests were made. A resistance of 161 ohms in the lightning rod, however, is sufficient, in my opinion, to occasion all the phenomena of discharge which have been observed during heavy storms. The supply pipe is iron, and leads directly to a spring half a mile distant, where the best earth connection in the country is found. Owing to the insulating quality of the foundation upon which the house rests, the house constitutes one side of a leaky condenser, of which the slate and limestone form the dielectric, and the earth the opposite side. When a thunderstorm occurs, the whole house is charged in a greater or less degree; and as the earth connection of the lightning rod is insufficient to carry all the electricity which it receives, the electricity is discharged through every available channel, of which the supply pipe is the best. In light storms, the phenomenon would not be noticed; it becomes very marked in heavy ones.

In this case the supply pipe was the safety valve of the house. The proprietor of the house was advised to connect the lightning rod to the supply pipe by a large copper wire, which will probably terminate the curious phenomena which have been observed.

I trust the time will soon come when lightning rods will be erected by persons possessed of sufficient electrical education to be able to tell whether they have a resistance of 161 ohms or of 0. Probably no important business at the present time, is as a rule, entrusted to a class of men so utterly ignorant of their duties as this one. In every case where a building supplied with a lightning rod is destroyed by lightning, the parties who put up the lightning rod ought to be prosecuted. A vigorous course of treatment of this sort would soon convince these people that a reasonable amount of study of the laws of electricity is necessary for their own safety as well as that of their patrons.

I wish that every electrical phenomenon which occurs could be promptly and carefully investigated by competent, practical electricians. Why cannot the scientific departments of our colleges undertake this service? It would furnish a fund of accurate information which would prove of very great practical value.

New York city. GEORGE B. PRESCOTT.

Purification of Hen Houses.

Advice like the following, which we find in the *Live Stock Journal*, is always in order:

As the hot season advances, poultry keepers should not neglect the purification of the fowl houses. Proper sanitary measures must be taken, or health and successful poultry raising cannot be expected, nor is it deserved. Lime is an excellent purifier, and, when carbolic acid is added to the whitewash, will effectually keep away vermin from the walls. After every cleaning of the floor it should be sprinkled with carbolic acid; dilution, twenty of water to one of acid. This is one of the best disinfectants and antiseptics known, and is not used as much as it deserves. The roosts should be sprinkled with it every week. This whitewashing should be done twice at least, better three times, a year. The nests of sitting hens should be sprinkled with carbolic acid to keep off vermin; and the coops also, where young broods are kept for a time, should be purified in this way. If a hen gets lousy, the dilute acid will destroy the lice, if put under the wings, and on the head and neck. Wood ashes are excellent to be kept in fowl houses for hens to dust themselves with. They are much more effectual than sand; but sand should also be kept for a bath. Without proper attention to these matters, poultry keepers cannot expect to succeed.

BORING BITS.

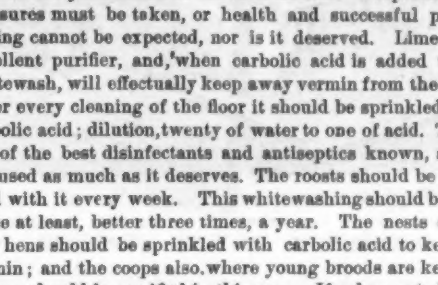
In continuation of our article on augers, published on page 133 of our current volume, we give the following illustrations and description of the various kinds of boring bits in use. The engravings are selected from the pages of Knight's "Mechanical Dictionary."*

In Fig. 1 and succeeding illustrations, various forms of bits are given. The gouge bit *a* (Fig. 1), before the invention of the pod, spoon, and twisted bits, resembled the half of a reed split longitudinally, and had a sharp end like a gouge.

The change to the spoon bit, *b*, was merely giving a conoidal end to the tool, which enabled it to enter more accurately at a given spot. This is the dowel bit used by coopers.

The nose bit or shell auger, *c*, has a long barrel, and the large sizes are used by the pump makers, and called pump bits.

Fig. 1.



Boring-Bit

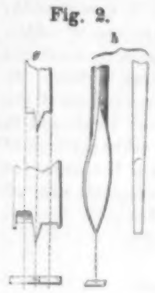
The chamfering bit, *d*, for opening holes so as to admit the conical heads of the ordinary wood screw, consists of a conical reamer with teeth.

The expanding center bit, *e*, consists of a shank and center point, and a chisel-shaped cutter, whose distance from the center is regulated by slipping the bar, like that of a beam compass, in the socket of the head, a set screw maintaining it at its adjustment. This serves for cutting out disks, or for cutting circles for inlaying.

* J. B. Ford & Co., publishers, New York city.

For cutting hard wood, such as the finger and key holes of flutes, bits are employed with a square point and two diametrical cutting lips, *g* (Fig. 2); the smaller one approaches very closely the character of a drill.

Fig. 2.



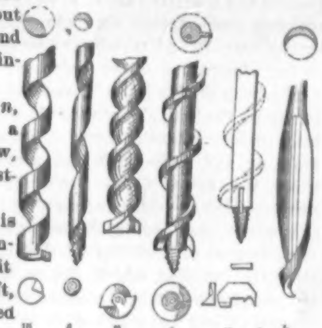
Boring-Bits.

The French bit, *h*, for hard wood, is a drill, and as such is used in a lathe head. The center point and two sides merge into an easy curve, which is sharpened all the way round and a little beyond the largest part.

The German pod bit, *k* (Fig. 3), has a long elliptical pod and a screw point. It makes a taper to the end of the hole unless it is driven clear through.

The spiral ribbon, *m*, is a bar having a half round section. This is twisted so as to throw the flat side to the exterior to form the outside of the cylinder; the inside is not filled up by the metal, but makes a hollow spiral, and the bottom end has a single cutting lip.

Fig. 3.



Spiral-Bits.

The twisted flat bar, *n*, assumes the form of a doubled threaded screw, no vertical vacancy existing in the twist.

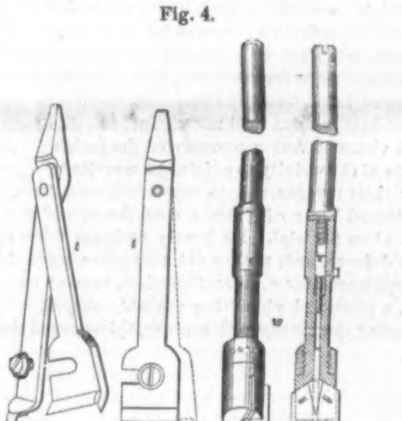
The spiral rib bit, *o*, is known, especially in England, as the American bit and has a cylindrical shaft, around which is twisted and brazed a single fin or rib.

Behind the worm, as in example *p*, may be a small diametric mortise for the reception of a detached cutter which has the nicking point and cutting lip of the ordinary center bit. The cutter is kept in its central position by a square notch which embraces the central shaft of the bit, against which it is forced by a wedge.

The grooved bit, *s*, has a cylindrical stem and spiral groove.

One form of expanding bit, *t*, Fig. 4, has a central portion which has the point, and a hinged portion which carries the scribe and the router. The movable portion is set by a screw, so as to regulate the radius of the hole.

Fig. 4.



Expanding-Bits.

Another form, *w*, has three radial cutters, which are expanded by means of a taper wedge and an axial screw. The latter is operated by a screwdriver, whose end is introduced into the socket, the threaded end of which is the means of securing it to the brace.

A Roman Tunnel in Algiers.

Several civil engineers, engaged with the surveys for a water conduit from Touja to Bougie, have made a very interesting and important discovery. A mountain which was situated in the proposed line of the conduit was to be tunneled for a length of 500 yards; and in searching for the most suitable place the engineers discovered an ancient tunnel 6 feet 8 inches in hight, and 19 feet 7 inches in circumference. It is supposed that this is the same tunnel mentioned in an epigraph found at Lambéoc, according to which the tunnel was built in the reign of Antoninus Pius, the plans being proposed by a veteran of the Third Legion, named Nonius Datus. Finding works like this after a time of 2,000 years, we cannot but be greatly astonished at the power, energy, and genius of a nation which produced, with the limited means available at those times, such gigantic structures.—*Stummer's Ingenieur.*

Successful Swimming Across the English Channel.

Captain Webb, after failing in his first endeavor to swim from Dover, England, to Calais, France, has succeeded in his second attempt, and has traversed the distance, some twenty-one miles, in twenty-two hours and forty-three minutes. This is certainly the most wonderful feat of swimming ever accomplished. Captain Webb wore no life-preserving apparatus whatever, but swam without clothes.

It is not difficult to imagine a man possessing muscular power sufficient to sustain such extraordinary exertion, but that it could be exercised during so long a sojourn in the water, the effect of which is to cool the body below its normal temperature, and so largely diminish the vital force, is surprising.

IMPROVED COOKING CHAMBER.

We illustrate, in the annexed engraving, a new chamber or covering for the top of cooking stoves, whereby all odors, steam, smoke, and other emanations from cooking are drawn off from the apartment in which the cooking is done. By means of the same device, it is claimed that the heat of the stove during hot weather may be conducted away, and in cold weather may be utilized for warming other portions of the house. The chamber also serves as a hot closet for drying fruit, and as a plate warmer; and through its use, we are informed, boiling can be done with less fire and in a shorter space of time than upon the open stove.

The box is made of sheet metal. The heat may be led into the chimney by a short pipe, as represented in the engraving, or the pipe may be extended into another room and terminate in a suitable register. The top and back of the chamber are united; the upper portion has a grating floor, A, so as to form a separate compartment, access to which is had by the door, B, and which may serve as a receptacle for warm plates or for other uses. At the back of the lower chamber, and also on top of the box, shelves are placed for setting cooking utensils upon. The sides are movable, and slide back and forward. To these, the front doors are hinged. By pushing back the sides and opening the doors, the whole chamber is thrown open, giving free access to the top of the stove. A frame is supplied, which fits on top of the latter and serves to hold cooking vessels. The apparatus can be attached to any make or pattern of stove by elongating the ribs or frame and by enlarging the doors. It can be easily taken apart and packed for transportation.

Patented April 13, 1875. For further information address the inventor, Mr. John D. Smedley, Syracuse, N. Y.

SMEDLEY'S COOKING CHAMBER.

Excommunicated Insects.

Apropos of the efforts in progress to destroy the phylloxera and other insect scourges in France, a writer in *La Nature* gives a curious bit of information relative to the way in which such pests used to be proceeded against when Science, save so far as it could be made to agree with theological dogmas, had no existence for the world. In 1120, the Bishop of Laon formally excommunicated all the caterpillars and field mice. In 1488, the grand vicars of Autun commanded the parish priests of the vicinity to enjoin the weevils to cease their ravages, and to excommunicate them. In 1535, the Grand Vicar of Valence cited the caterpillars to appear before him for trial. He kindly assigned them counsel for their defense, and, as they did not appear, proceeded against and sentenced them, *in contumaciam*, to clear out of his diocese, a command which they probably obeyed.

During the seventeenth century, thirty-seven similar judgments, against both insects and quadrupeds, were issued. One is on record, during the eighteenth century, fulminated against a cow; and there is still another, of later date, due to a judge of Falaise, who condemned and hanged a sow for killing a child.

IMPROVED ORNAMENTAL MOLDING MACHINE.

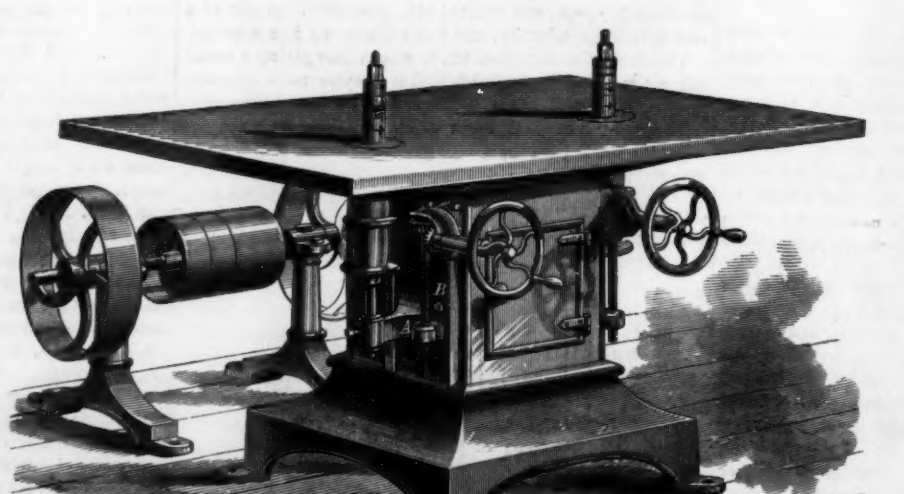
The object of the invention illustrated herewith is to combine several valuable improvements suited to molding machines in the simplest form.

By the arrangement here shown, a staunch and unyielding frame is secured, that will admit of great speed of the running parts, and prevent any twist or cramp that would tend to increase the friction in the boxes from an imperfect or yielding floor upon which it may be placed. The boss or foot of the frame is cast separate from the trunk or post, and the two are fitted and bolted together, or they may be both cast in one piece. These together make the main frame of the machine, to the sides of which the yokes or box frames are attached. The boxes are connected together by a broad plate, A, which has V-shaped edges that fit into correspondingly shaped grooves in the perpendicular ribs cast upon the sides of the main frame, and the yokes are thus held to the frame by gibs, B. The yokes carrying the cutter shafts are moved up and down by means of the screws operated by the hand wheels and bevel gears. The screw and hand wheels rest in stands that are attached to the main frame near the top. By this movement the cutters are brought to any desired hight in relation to the top of the table of the machine, thereby readily adapting the cutters to the work in hand. By this mode of construction the belts and all other working parts of the machine are on the outside of the frame, convenient to the hand of the operator when adjusting, oiling, or repairing. At the top of the frame are two girts or arms firmly attached, one upon the front and one upon the back. Upon these rests the plate or top of the machine, which is secured to them by screws.

In the top, around each cutter head, are nicely fitted a series of rings that are removable when the operator desires to place the cutters so as to have them operate upon the under side of the piece to be cut or molded. The apparatus is thus rendered less liable to accident when applying the work.

It is claimed that the machine is capable of being run at a high rate of speed, with scarcely any perceptible jar or vibration, giving an easy, smooth, rapid cut, and that consequently a greatly increased amount of work can be done with less labor.

The machine and its improvements are covered by four patents, the latest dated April 9, 1872. For further particulars address the patentee and manufacturer, Jonathan P. Grosvenor, 12 Fletcher street, Lowell, Mass.



GROSVENOR'S ORNAMENTAL MOLDING MACHINE

Carbonic Acid Gas as a Motive Power.

On this subject, Professor de Repentigny (of St. Therèse College, Canada) writes us that he has discovered a method by which the gas may be obtained in large quantities, and at a very moderate cost. There exists in Canada a peculiar formation known as gray iron sand, which contains a large proportion of carbonate of lime. He says: "It is very common in this section, and may be found in immense quantities." When treated with dilute oil of vitriol, a complete solution of the sand ensues, accompanied by a copious liberation of carbonic acid ($FeCO_3 + H_2SO_4 = FeSO_4 + CO_2 + H_2O$) The residue remaining, consisting chiefly of a solution of copperas, along with sulphate of manganese, lime, and other impurities, he treats with ferrocyanide of potassium for making Prussian blue.

Soundings in the Gulf of Mexico.

The U. S. Coast Survey steamer Blake, Lieutenant Commander C. D. Sigsbee commanding, has recently returned to Washington, after an excellent winter's work in running lines of soundings in the Gulf of Mexico. These deep sea examinations are the first ever made in that portion of the ocean, and consequently, in points of novelty, are on a par with those of Commander Belknap of the bed of the Pacific. Steel pianoforte wire, No. 22 gage and weighing but 14½ lbs. to the mile, was employed as a sounding line with uniform success, even in heavy seas.

The results show that the slope of the delta of the Mississippi is gradual, and that the deepest water in the vicinity is on a prolongation of the axis of South Pass. At the end of that line, 120 miles distant from South Pass lighthouse, the depth was 1,632 fathoms. The limiting lines of the system of lines, which was run by the Blake, extend (magnetic) east, half mile south of Pass à l'Outre, at the end of which was found 426 fathoms, and southwest of Southwest Pass, which ended in 608 fathoms. On the latter line was found the only abrupt irregularity of the bottom found off the delta. Up to April, the currents immediately off the passes set generally to the westward, after which they appeared to set gradually to the eastward. On May 4, the Blake commenced a line between Southwest Pass and the Rio Grande. Until half the distance between the ends of the line had been passed, the depths were not great; but afterward the water deepened, the greatest depth on the line being 900 fathoms. About 105 miles from the Rio Grande, at seventeen miles from the Southwest Pass lighthouse, the water had deepened to 32 fathoms, after which it shoaled gradually to as little as 18 fathoms, and 30 fathoms was not reached again until ninety-four and a half miles from the lighthouse

On May 6 a sounding was got in 47 fathoms, the sounding rod bringing up hard bottom—enameled shells, etc.—(the only instance in which hard bottom was obtained during the season Tortugas was neared). At a sounding in 583 fathoms, in latitude 27° 07' north, longitude 94° 35' 15" west, the sounding rod brought up dark mud, or ooze, which emitted so offensive an odor as almost to drive the people from the forecastle, where the sounding operations are carried on. The odor soon passed away.

On May 9 commenced the longest line run during the season, that from the Rio Grande to Tortugas, a distance of about 760 miles; 100 fathoms was not reached until about forty miles from the Rio Grande; the water then deepened rapidly. At about 100 miles from the Rio Grande the depth was 839 fathoms, whereas the previous and following soundings were respectively 1,386 fathoms and 1,648 fathoms. This was the only marked peculiarity of the bottom found on the line; soundings varied from 1,600 to 2,100 fathoms, the bottom being undulating, apparently. No northern extension of the bank of Yucatan was discovered. The greatest depths were 2,008 fathoms, 2,025 2,016 fathoms, and 2,119 fathoms. The average specific gravity of the water of the Gulf is about 1·0265.

The following is an example of the quickness with which the Blake does her work: On one occasion she got the following results in actually one hour from the time of stopping the engines to sound to the time of steaming ahead again: A sounding in 1,500 fathoms, with a specimen of the bottom, water specimens, and temperature, at the surface and at the following depths in fathoms: 100, 300, 600, 900, 1,200, 1,500. There were but seven men on the watch to accomplish this.

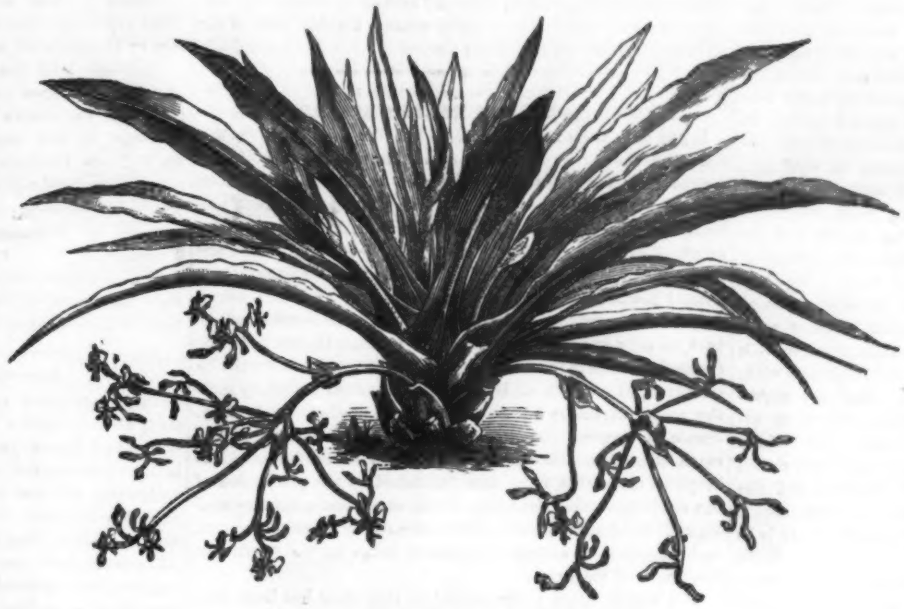
During the summer the Blake will work in the Gulf of Maine, when the new machine will be tried, as also a new sounding rod by Admiral Porter, and another by Mr. Wilson of the navy yard.

Metal Glass.

Another hard glass, to which the above name has been given, has been produced at Count Solm's works, near Buntzlau, Germany. The tests withstood appear to be about the same as those to which the Bastie glass was subjected, with the exception, however, that the metal glass is indifferent to cold water when highly heated. The Bastie glass breaks under similar conditions. The treatment to which the glass is subjected in the new process is not made public; but it is probably, like the Bastie method, a system of annealing.

COCHLIOSTEMA JACOBIANUM.

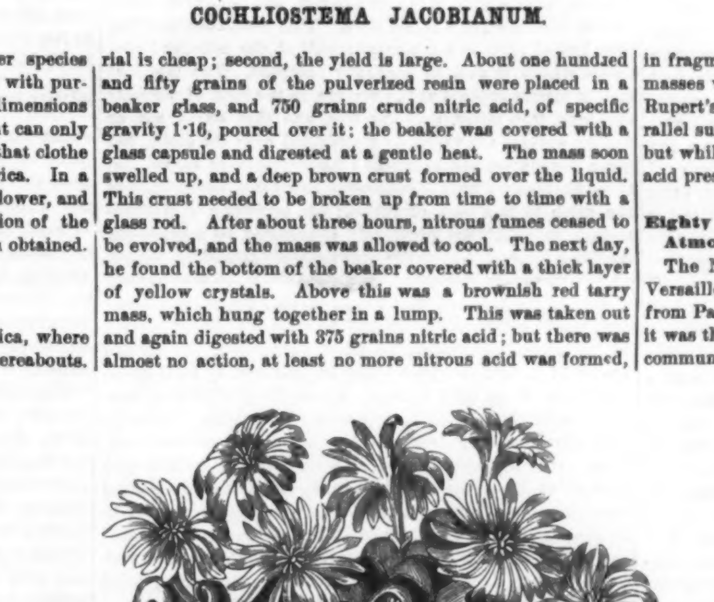
This singular plant, with agave-like foliage, and somewhat orchid-like blossoms, is one of great beauty. A plant belonging to the same genus was introduced in England some few years ago, and more than one of the principal nurserymen flowered it successfully. M. E. André, however, who, in the *Revue Horticole*, recently gave a figure of what he deems to be a new species, appears to think that the elder species is now entirely lost to the English gardens; but whether he has sufficient proof that such is the case we doubt. Our engraving will serve to convey an excellent idea of the agave-like foliage of the plant described as a new species by M. E. André. An engraving, however, can give no idea of the beauty of its inflorescence. The petals of the flowers, which are of a soft velvety purple, measure 1½ inches across, while the sepals are of a pale rosy white. The spoon-shaped bracts are of a deep bright salmon color, the whole of the stalks being of a paler tone of the same color, flushed at the joints with a full brownish pink. The flowers exhale a delicate perfume, similar to that of certain *oncidiums*, to the blossoms of which they present a superficial resemblance. The beautiful flowers of *c. Jacobianum* have the defect of being exceedingly evanescent, as noticed in the previously known species which has flowered in England. This defect, however (which is peculiar to nearly all commelynaceous plants), is more than counterbalanced by the profusion with which the flower spikes are seemingly produced on well grown plants. In the new (?) species described by M. E. André, he relies for its distinctness on the following differences from the old one: First, by the far less hirsute character of the flowers; and secondly, by the uniform green of the leaves, the elder species having them either strongly blotched or bordered with purple. He also relies on the much larger general dimensions of the plant. It is presumed that so large a plant can only be an epiphyte upon some of the forest giants that clothe the deep slopes and valleys of equatorial America. In a shaded part of the stove house it is not difficult to flower, and its multiplication may be effected by the separation of the small lateral buddings until seeds shall have been obtained. It is well worthy of a place in the orchid house.



COCHLIOSTEMA JACOBIANUM.

MESEMBRYANTHEMUMS.

These beautiful flowers belong to South Africa, where there may be found no fewer than 250 species or thereabouts. For the sake of convenience, Haworth has divided mesembryanthemums into forty-three sections and sub-sections. *M. debile* and *crassifolium*, though thought by some to be Australian species, nevertheless belong to the Cape, and probably went first to Australia from there or from England. *M. cordifolium* (the ice plant), so well known in country districts, was sent to England a few years ago by Baron Müller; but it is likely that some plant-loving emigrant took it out to Australia. The majority of mesembryanthemums are easily grown, and make firstrate window and rockwork plants. Common garden soil suits them perfectly; the kinds represented in the accompanying illustrations, and their immediate congeners, may be placed among fancy sorts—little gems well worth cultivating on account of their quaintness and variety rather than as subjects for purposes of general decoration. For those who are fond of uncommon forms among plants, but who have little time or space to devote to their culture, these are plants well worth attention. *M. minimum*, of which we give an engraving, belongs to the sphæroide section, a group in which there are four others, *m. truncatulum, obconellum, nuciforme*, and a new species which is much larger than the others, and which has been named *m. truncatellum*. These plants never form a stem, and increase in size by bursting through the fleshy top, when the outer part shrivels up, and the new formation takes its place. The flowers, which issue from the center, are pale rose. Plants like these require to be potted in very sandy soil, and require to be well drained, when they will grow well. *M. testiculare*, of which an illustration is also given, is a rare and beautiful plant, with a skin as smooth as silk, and very glaucous. It is sometimes called *m. octophyllum*, but we never yet saw it with eight leaves. It is somewhat delicate, and should be potted in half silver sand, the other half being loam and brick rubbish, and should be kept near the glass in a dry house. *M. fissum* is closely related to this species, but it is more easily cultivated than *m. testiculare*. Among the most interesting of the mesembryanthemums are *m. tigrinum* (tiger's chap), *m. lupinum* (wolf's chap), *m. felinum* (cat's chap), *m. erminum* (rat's chap), *m. murinum* (mouse's chap), and *m. mustellinum* (weasel's chap), all exceedingly interesting, and easily cultivated kinds; their flowers, which are all yellow, open in the afternoon. They form valuable plants for rockwork in summer, standing well out of doors in the south of England from May until October. They are easily propagated by pieces pulled or cut off and laid in the sun on moist sand, where they root freely in a few weeks, and often keep on flowering as though nothing had happened.



MESEMBRYANTHEMUM MINIMUM.

MESEMBRYANTHEMUM TESTICULARE.

A Profitable Source of Picric Acid.

G. C. Wittstein calls attention to a new source of picric acid. This is a long and well known drug, the resin of *xanthorrhœa arborea*, a plant which is a native of Australia. It is known as acaroid resin and as the yellow resin of Botany Bay in New Holland (*resina acaroidis* and *resina lutea Novi Belgii*). The advantages of using this substance for the manufacture of picric acid are twofold. First, the material is cheap; second, the yield is large. About one hundred and fifty grains of the pulverized resin were placed in a beaker glass, and 750 grains crude nitric acid, of specific gravity 1·16, poured over it; the beaker was covered with a glass capsule and digested at a gentle heat. The mass soon swelled up, and a deep brown crust formed over the liquid. This crust needed to be broken up from time to time with a glass rod. After about three hours, nitrous fumes ceased to be evolved, and the mass was allowed to cool. The next day, he found the bottom of the beaker covered with a thick layer of yellow crystals. Above this was a brownish red tarry mass, which hung together in a lump. This was taken out and again digested with 375 grains nitric acid; but there was almost no action, at least no more nitrous acid was formed, and no crystals were deposited from this second liquid on cooling, showing that it is unnecessary to treat the resinous mass with nitric acid a second time. In the present case it was desirable to lose as little as possible of the product sought; hence, after the crystals that formed had been taken out, the second liquid was added to the mother liquor and evaporated to dryness. The first crystals were added and the adhering nitric acid driven off at 212° Fah. The total residue weighed 100 grains, almost ⅔ of the resin taken; it was yellow and crystalline, and contained nothing amorphous but single crystals of oxalic acid. The picric acid thus obtained, after recrystalizing to secure the oxalic acid, weighed 75 grains. Hence, the yield is 50 per cent of the crude material.

Fused Boracic Acid.

Fused boracic acid, which approaches glass in some of its external characteristics, presents some properties worthy of note. In the viscid state it may be drawn out into threads, which solidify rapidly, and from this point of view its ductility rather resembles that of silica than of glass. Its hardness, between 4 and 5, places it between fluor spar and apatite; it scratches glass, and is with difficulty attacked by sand, and even by emery, dry or with oil. It takes seven to eight times as much time in grinding as glass under the same circumstances. This resistance to friction, which does not accord with its hardness, depends doubtless, as M. Damour has recognized in the case of other minerals, on a speciality of structure. Melted boracic acid, in mass, becomes slowly hydrated in contact with water. In powder it is acted on rapidly, as shown by Ebelmen. If the powder is sprinkled with water, its temperature may rise to 100°. Boracic acid is chiefly remarkable for the persistence of its temper. If poured upon a cold metallic surface, glassy plates are obtained, the under surface of which, chilled by the metal, is more strongly tempered and more expanded than the upper. Hence results a flection which may be strong enough to cause the rupture of the plate and its projection in fragments. If poured into oil it may be obtained in small masses with short tails, under the same conditions as Prince Rupert's drops. A tempered plate of boracic acid, with parallel surfaces, acts upon polarized light like tempered glass; but while the latter loses this property by re-heating, boracic acid preserves it with great tenacity.—*V. de Luynes.*

Eighty Miles an Hour in Pneumatic Tubes.—The Atmospheric Post between Paris and Versailles.

The National Assembly of France holds its sittings in Versailles, a kingly residence distant some eleven miles from Paris. The latter is the real seat of government, and it was therefore of great importance to introduce a means of communication by which official documents could be transmitted between the two places, at any moment when required, with great rapidity. For this purpose the pneumatic method has been put into operation, with much success, and it is stated that letters and packages are now sent through, in either direction, in eight minutes' time, being at an average velocity of more than eighty miles an hour.

To produce this enormous velocity—the tubes being only four inches in diameter—requires the use of three steam engines having an aggregate of one hundred and fifty horse power, besides other extensive apparatus, which we will briefly describe, quoting from a recent number of the *Engineer*.

A report on the system of M. Crespin, on the application of pneumatic power over long distances, has been reported upon by M. Tresca, of the Conservatoire des Arts et Métiers, with the Academy of Sciences, and the report is now published. We copy from the *Engineer*.

When it was found necessary to connect Paris and Versailles by means of a pneumatic tube, it was impossible to make use of the method adopted in Paris, which only gives the required speed over a distance of about 1 mile. The problem was to apply the same force along a line from 11 to 12 miles in length. This result has been obtained by the adoption of an apparatus called a relay, which, placed at various points along the line, acts upon the train and urges it at full speed to the next station. The column of air within the tube is set in action by forcing or by exhaustion, and the two operations are employed concurrently, but in a novel manner.

As in the pneumatic telegraph, M. Crespin uses a series of boxes to form a train; the impulse is given by forcing the air in at one end of the tube and exhausting it at the other; the pressure accumulated in the reservoirs comes into action at the moment the train passes a relay, and continues until the arrival of the train at the next post, when it is taken up by another reservoir, and so on to the end.

The line is double, up and down, and each is divided into sixteen sections of 3,650 feet in length, and each section has its relay. The necessary motive power is obtained from three stations, one at each end of the line, the other in the middle. The last is the most important, and comprises two engines of fifty horse power each, with pumps capable of exhausting the 280 cubic yards contained in the part of the line it serves in ten minutes, at the same time storing it in the reservoirs under the pressure of one atmosphere, necessary to supply successively behind the train 188 cubic yards

of air, representing 11 miles in length. The two stations at the ends of the line have each two engines of twenty-five horse power, with pumps, which in ten minutes exhaust nearly 3 miles of line, and which at the same time compress in the reservoirs sufficient air to fill, at the moment required, double that length of line.

The reservoirs at each of these three stations are connected together by means of cast iron tubing, 5 inches in diameter, placed in the same excavation as the main tubes, at a depth of 2½ feet, and opposite to each relay a branch is connected with a reservoir, containing 20 cubic yards of air for the service of the relay in both directions. The relays are placed under the main tubes in a small chamber closed by a trap similar to those used for sewers. The exhaust relays are placed at two points, each one quarter of the length of the line from the end, and consequently with half the length of the line between them. The exhaust receivers are much larger than the others, and they are connected with the central establishment by means of cast iron pipes 4 inches in diameter, which contribute to regulate the action of the exhausting engine. In order to insure regularity in working, large reservoirs are also placed at each end of the line, and all the accumulators of pressure are in communication with each other. At the central station, the capacity of the pressure reservoirs is 80 cubic yards, and those at the termini half that amount. The exhaust reservoirs have a capacity of 97 cubic yards at the central station, of 60 cubic yards at each intermediary station, and of 52 cubic yards at each terminus. The last named are not in communication with the rest, and thus 5½ miles of tubing are dispensed with.

With this arrangement no obstacle can arrest the movement of the trains; the pressure in the reservoirs is an atmosphere higher than that of the ordinary air. The train is introduced through a kind of sluice gate, or chamber, closed by means of a valve at the entrance of the line, and the train is furnished with a piston fitted with leather, which has precisely the contour of the tube. When the train is in place, the valve is opened and the pressure turned on. With a pressure of one atmosphere behind, and a partial vacuum in front, the train starts with a speed of 130 feet per second, or 7,800 feet per minute; and at the moment of passing the first pressure relay, at 3,650 feet from the terminus, it opens behind it a large valve, which places the line in communication with the reservoir of 20 cubic yards placed at the foot of the relay, and this second current of air takes up the work. When the train arrives at a station, an electric bell informs the attendant at the station last past, and he closes the valve there.

In order to suspend the current of air of one relay, after the train has entered the next section, the pressure itself is made use of to set in motion a piston in the cylinder; this piston moves, of course, at the same rate as the current of air, and it is so calculated that the piston stops at the end of the section. Admission is thus cut off, but the tube is full of compressed air. When the train has passed the third and fourth sections of the line, and has arrived at the first vacuum relay, the compressed air which follows the train acts on a piston freed by the train, and this piston enters rapidly into a cylinder with a valve, which puts the up line in communication with the exhaust of 60 cubic yards at this station. The compressed air escapes rapidly through a safety valve placed above the exhaust relay. As soon as the train has passed the fourth section, the current of air of the relay presses on the exhaust valve, closing the line, and the train proceeds at the same rate as before; but by a special arrangement, the speed slackens towards the terminus to avoid any shock. The time occupies in the transit is eight minutes.

The pneumatic tube itself is formed of wrought iron tubes brazed, 4 inches interior diameter, with a thickness of $\frac{1}{8}$ inch, and weighing about 26 lbs per meter run = 8 lbs. per foot. They are joined together by means of six bolts with an india rubber washer between. In places the tube is curved, but the radius generally exceeds 19 feet.

The working of the line is regulated throughout by electric signals, and a special wire connects all the pressure relays, and tells whether they are in action or not. The carrier pistons are of iron, with an interior diameter of 3¼ inches, and 9 inches in length; the boxes are placed in a case which is slightly conical. On the outer surface of the carrier pistons are fixed two strips of metal which are turned to 3·95 inches, and started longitudinally so as to produce rotation, this arrangement causes the wear to be equally distributed, and, should a grain of sand get into the tube, it prevents stoppage by friction. The piston is also hollow and similarly provided, and between the two strips of metal there is a series of openings into the interior to receive any dust which may arise from the wear of material. The packing leather is fixed solidly between two washers by means of a bolt at the end.

The exhaust relay consists of a piston which enters a vertical cylinder, and draws with it a disk, which closes the pneumatic line, and a valve, which opens a large rectangular orifice communicating with the reservoirs. The top of the cylinder in which the piston moves is connected by a tube with the back part of the valve above mentioned, and above the valve is a grating closed by a clack. The piston is held down by means of a bolt until the passage of the train, when the adjoining pressure relay comes into action. The piston thus released has then its upper portion in relation with the exhaust and the lower acted upon by the pressure of two atmospheres, and therefore it rises rapidly into the cylinder and closes the line, at the same time opening the lower valve by which the exhaust is effected; all the air at a pressure superior to that of the atmosphere has been expelled by the safety valve placed above, so that the aspiration only draws off air at the normal pressure. The pressure relay is the main feature of the arrangement; but should it not act, the train is only retarded, not stopped.

Each of the pressure relays is in immediate communication with its reservoir of 20 cubic yards for accumulating the pressure. These reservoirs are formed of iron plate like ordinary boilers, and are tested to about 570 lbs. per square inch; they are made cylindrical in form, the ends being closed with a single plate; they are 16 feet 6¼ inches long and 6 feet 6¾ inches in diameter; the exhaust receivers differ from the others by having their ends concave without and convex within. The tubes which connect the relays of pressure are about 5 inches in diameter, and those of the exhaust 4 inches. The pumps make forty strokes a minute, are single action, with cylinders 3 feet 3¾ inches in diameter, and 4 feet stroke; they draw or force nearly 1 cubic yard of air at each complete stroke of the piston.

[For the Scientific American.]

THEORIES OF THE EARTH'S INTERIOR.

It has long been known that, as we descend towards the center of the earth, the temperature rises at the rate of one degree Fah. for about 50 to 60 feet of descent. In artesian wells and other deep excavations, the increase of heat has been noted and mathematically calculated; but so many elements of error enter into the computation—among which are heat due to friction of the implements used in excavation, animal heat of those engaged in the work, and currents of air from the surface—that the results can be considered, at best, as only approximations to the truth. If the heat increased uniformly from the surface to the center, it would be sufficient, at a depth of two or three hundred miles, to melt the most refractory substances to be found at the surface. Hence the general conclusion is that the solid crust of the earth cannot be over two hundred miles in thickness. But Hopkins calculates, from data furnished by the precession of the equinoxes, that the crust of the earth has a thickness of eight or ten hundred miles, while Hennessey's investigations, in a similar way, assign six hundred miles as the maximum thickness of the crust.

Till within a few years, all below this crust has been supposed to be in a state of igneous fusion, and our earth to be, for the most part, in a liquid state. This conclusion has long been looked upon as a necessary result of the nebular hypothesis which is now so generally accepted. The fact that molten matter appears at the surface, in the form of volcanic ejections, trap dikes, and the like, and that warm, hot, or boiling springs are variously distributed over the globe, has given foundation and sufficient authority to these views. But these phenomena are not conclusive proof that the interior of the earth is in a state of fusion; for, according to Mallet—though in substance previously enunciated by others—the crushing force, due to the lateral pressure caused by shrinkage of the earth's crust, is sufficient to melt the hardest rock; and the pressure that would crush 7,200 cubic miles of rock would generate heat enough to cause all the volcanicity on the globe. According to other authorities, the melted matter of volcanic eruptions may be produced by local chemical action in the earth's crust. Again, the diversity of composition in the ejected matter would tend to the conclusion that all cannot come from a single and uniform molten mass. Many veins of rock, also, which were formerly looked upon as injected into or through the surface strata from the melted mass below, are now regarded by many eminent geologists as of aqueous origin, and formed by the percolation of heated water holding solid matter in solution through the surrounding rocks into a fissure, and its subsequent evaporation, which left the rock material to gradually fill the fissure.

Recent observations of Hopkins have shown that the melting points of various bodies, as wax, sulphur, and resin, are greatly and uniformly raised by pressure; and, from analogy, the opinion is now gaining ground that the interior portion of the earth, though heated far above the point of fusion, may be solid from the great pressure to which it is subjected. While it is now considered true that sufficient pressure on ice—which expands in freezing—will change it to water, pressure upon any substance that contracts in the process of congelation, like rock, would, on the other hand, aid in its solidification. Hence the conclusion is that the pressure existing at great depths would make solid the molten mass at a temperature at which, under a less pressure, it would have remained liquid.

There are two hypotheses based on the supposition of a solid nucleus. The first, maintained by William Hopkins, Scrope, Shaler, and others, supposes solidification to have commenced at the center of the liquid globe, and to have advanced towards the circumference. Before the whole mass was congealed, the portion near the surface became of so great a consistence as to prevent the sinking of the cooled and heavier particles, thus giving rise to a superficial crust, from which consolidation would proceed downwards. Between the nucleus and the crust is conceived to be matter still in a state of more or less perfect igneous fusion, either forming a continuous sheet of comparatively slight depth, or deposited in isolated reservoirs or subterranean lakes. It is interesting to notice, in connection with this hypothesis, that a similar one was reached from the study of terrestrial magnetism. Halley "supposed the existence of two magnetic poles situated in the earth's outer crust, and two others in an interior mass, separated from the solid envelope by a fluid medium, and revolving, by a very small degree, slower than the outer crust."

The second hypothesis is credited to Dr. T. Sterry Hunt. He accepts the first hypothesis so far as to admit a solid nucleus and a superficial crust. But he conceives it to be improbable that the cooling of the crust should have commenced at so early a period that the molten matter beneath it was too deep to become entirely solidified by subsequent refrigeration. He holds that only a thin belt of partially fluid matter exists between the solid exterior and the core, and argues, with Sir John Herschel, that this layer is not matter still unsolidified, but the under portion of the crust encroached upon by internal heat, "disintegrated and modified by chemical and mechanical agencies, impregnated with water, and in a state of igneo-aqueous fusion." Keferstein whose work, published in 1834, has been generally overlooked, considers the liquid stratum, or seat of volcanic action, as part of the sedimentary formations which have been subjected to a peculiar kind of fermentation, which crystallizes and arranges the elements in new forms with an evolution of heat as the result of chemical action. But Hunt rejects as irrational the idea of subterranean combustion or fermentation as a source of heat.

Professor Hall denies that we have any positive evidence of a former molten condition of any considerable portion of the earth, but denies it absurdly, on the lack of the visible exposure of any considerable part of the primitive crust. Sir William Thomson argues that the phenomena of precession and mutation demand greater rigidity of the earth than would be possible with a comparatively thin crust. This is opposed by Delaunay, but is again recently defended by Thomson.

The question respecting the earth's interior lies at the very foundation of the disputed theories of mountain formation, of earthquakes, and of volcanic action. S. H. T.

The Steam Yacht Hermione.

The steam screw yacht Hermione has been recently constructed for Captain W. H. Gordon, R. N., by Messrs. Edwards and Symes, yacht builders, Cubitt Town, London. She is one of the fastest of her size and construction afloat; the following are the principal dimensions: Length, 55 feet, breadth, 11·0 feet, depth 5 feet 4 inches; diameter of cylinders, 8 inches; length of stroke, 9 inches; heating surface, 325 square feet; grate surface, 13 square feet. When the engines were worked about three quarter power, the speed was 13 miles an hour, or 11·28 knots, the number of revolutions 220 per minute, and mean effective pressure in cylinders 80 lbs. per square inch. The power developed would thus be 80·4 indicated horse power, and the constant in the Admiralty formula $C=\frac{s^3\times D^{\frac{2}{3}}}{\text{I.H.P.}}$ would be 120, an exceedingly good result for so small a yacht. From these results it is anticipated by the builders that, when the engines are worked to their full power, namely, 120 indicated horse power, at least 14½ miles or 12·58 knots will be obtained. The yacht is constructed entirely of teak and mahogany, coppered, and copper fastened, and is fore-and-aft schooner rigged, and, considering her great power and speed, has good accommodation for crew forward, while she has a neat polished mahogany cabin aft, and her fittings throughout are of a superior quality. The engines are high pressure surface-condensing, with inverted cylinders, and fitted with separate variable expansion valves, and screw reversing motion of most compact and effective construction. The condenser and pump are small, being only required to condense the steam for supplying the boiler; but when working at half speed a good vacuum is obtained, or by means of a suitable cock the exhaust can be turned into the chimney. The propeller shaft is of steel, cased in gun metal and fitted with one of Hirsch's patent propellers, which works very satisfactorily, and with little vibration. The boiler is of locomotive construction of steel with brass tubes, and has been proved to 200 lbs. per square inch. It is fitted with a superheater and has given very good results, making steam well. We may here mention that the above firm have recently constructed the beautiful little steam launch Black Angel, 33 feet keel, 5 feet 6 inches beam, built entirely of mahogany, copper fastened, for Messrs. Willans and Ward, and fitted by them with Willans' patent three cylinder engine, which worked very satisfactorily, driving the boat at a speed of 13 miles per hour. The total weight of boat and machinery was under 2 tuns. The engines are very neat, and most compact and handy. Messrs. Edwards and Symes have likewise in construction the first ferry boat for the Thames Steam Ferry Company for heavy goods traffic, plying on the Thames between Rotherhithe and Wapping.—*Engineering.*

Pictorial Tiles.

A comparatively new mode of employing tiles for the lining of rooms has been introduced by Messrs. Simpson, who have decorated the interior of several important buildings in this manner. The tiles are placed together in their unglazed state, and a picture is painted upon them in colors suitable for firing. They are then taken asunder and put into the furnace, and then subjected to great heat and glazed. If this is successfully accomplished, the tiles can now be fixed against the wall of the room and present an absolutely indestructible decoration, which can be washed as often as it is needed, though from its high glaze it is not easily apt to catch dirt.

Copying Pencils.

Pencils are now sold by stationers, the marks of which may be copied in the same manner as writing made by the pen with ordinary copying ink. The method of preparing the leads is as follows: A thick paste is made of graphite, finely pulverized kaolin, and a very concentrated solution of aniline blue, soluble in water. The mixture is pressed into cylinders of suitable size and dried, when it is ready for use. Gum arabic, it is said, may be substituted for the kaolin

Useful Recipes for the Shop, the Household, and the Farm.

A permanent and handsome reddish color may be given to cherry or pear tree wood by a coat of a strong solution of permanganate of potash, left on a longer or shorter time, according to the shade required.

Chloroform, which has undergone decomposition by exposure, can be easily purified by shaking it up with a few fragments of caustic soda.

Fruit is kept in Russia by being packed in creosotized lime. The lime is slaked in water in which a little creosote has been dissolved, and is allowed to fall to powder. The latter is spread over the bottom of a deal box, to about one inch in thickness. A sheet of paper is laid above, and then the fruit. Over the fruit is another sheet of paper, then more lime, and so on until the box is full, when a little finely powdered charcoal is packed in the corners, and the lid tightly closed. Fruit thus enclosed will, it is said, remain good for a year.

Pounded alum will purify water. One teaspoonful of alum to four gallons of water will cause a precipitation of the impurities.

To estimate the quantity of shelled corn on the cobs in any given space, level them, and measure the length, breadth, and depth; then multiply these dimensions together, and the product by four. Cut off the last figure, and the result will be the number of bushels of shelled corn and the decimal of a bushel.

Bee moths can easily be killed in large numbers by setting a pan of grease, in which is a floating ignited wick, near the hives after dark. The moths will fly into the light and fall into the grease.

The best way to catch hawks or owls is to set up a high pole with a steel trap on the top. The birds often alight directly in the trap.

Pictures may be transferred to painted surfaces in the following manner: Cover the ground with an even coat of light colored carriage varnish, which should be allowed to set (nearly as dry as if for gilding). If the print to be transferred be colored, soak it in salt and water; if not colored, use water alone. Remove superfluous water by pressing between blotting pads, and then place the picture face down upon the varnish, pressing it smooth. When the varnish is dry, dampen the paper and rub it off with the finger. The picture will be found upon the varnish, and another coat of the latter should be added to bring out the effect. This process answers equally well for glass or metal surfaces.

For the protection of iron and steel tools against rust, Vogel recommends a solution of white wax in benzine. The latter, heated, will dissolve half its weight of wax. This will preserve the metal, even from the action of acid vapors. Apply with a brush.

Round steel wire rope will bear more than double the weight required to break iron rope of similar diameter.

The following rule for strength of iron pipes is based upon the fact that a 10 inch pipe, one inch thick, will stand the pressure of 100 yards head of water. The coincidence of one inch of metal to every 10 inches diameter and 100 yards pressure should be remembered. For every inch in the diameter of pipe, increase or deduct $\frac{1}{10}$ of an inch; and for every yard of pressure, increase or deduct $\frac{1}{100}$ of an inch.

In calculating the strength of iron columns, the safe plan is to find the diameter of a solid column necessary to bear the compression, and then distribute the same area of metal in tube form or a hollow column.

A mixture of peroxide of manganese and water glass is recommended to be applied to cooking stoves when they are red hot, as it is said to make a good blacking, not as liable to burn off as common black lead.

According to recent experiments of MM. Kundt and Lehmann, the velocity of sound in pipes filled with water increases with the thickness of the sides of the tubes.

To make yellow wax into white wax, the former is boiled in water, spread out into thin layers, and exposed to the light and air. This is repeated until all the color is gone.

Cuttings of many kinds of plants, not usually increased with facility by amateurs, may be rooted easily in a Wardian case in the sitting room.

An Alloy of Copper Adherent to Glass.

An alloy of copper which will adhere to glass or porcelain is made by mixing from 20 to 30 parts of copper in powder, (obtained by the reduction of the oxide by hydrogen or by the precipitation of the sulphate by zinc) with sulphuric acid and then with 7 parts of mercury. The mixture is triturated and mingled with care. The acid is removed by washing in hot water, and the mass allowed to dry. At the end of 10 or 12 hours, the latter becomes quite hard and susceptible to a fine polish. On heating it softens, but on cooling does not contract. This alloy may also be used for joining delicate objects which will not withstand very high temperatures.

Chloral as an Anæsthetic.

Hydrate of chloral, administered hypodermically, has recently been used as an anæsthetic with success in the hospital at Bordeaux, France. The operation was a resection of the internal and external nasal nerve, involving some fifteen minutes' work and, necessarily, excessive pain to the patient. The drug took effect in eight minutes, and complete insensibility on the part of the sufferer resulted.

BRICKS made in Japan, and paying 20 per cent duty, are now imported into San Francisco. The quality is superior. Japanese brick makers can beat the world in the cheapness and excellence of their productions.

[American Chemist.]

Prices of Metals.

The prices of many of the dearest may be considered also as "fancy prices," and actually a whole pound of some of the metals named could hardly be obtained at even the extravagant figures annexed. In compiling the following table, we have taken the prices of the rarer metals from Trommsdorff's and Schuchardt's last price lists; we have assumed the avoirdupois pound as equal to 453 grammes, and the mark as equal to 24 cents gold.

An inspection of the table is not without interest; it is evident that the prices of the metals bear no relation to the rarity of the bodies whence they may be derived, for calcium, the third in the list, is one of the most abundant elements. Even that excessively sparingly distributed metal, indium, the most recently discovered element, stands tenth in the list, below strontium. The metals of the alkalies seem to occupy a remarkably low place in the table.

Metal.		Value in gold per lb. avoirdupois	Metal.		Value in gold per lb. avoirdupois.
Vanadium	cryst. fused,	$4792·40	Tellurium,	fused,	$196·20
Rubidium	wire,	3261·60	Chromium,	fused,	196·20
Calcium,	electrolytic,	2446·20	Platinum,	fused,	122·31
Tantalum,	pure,	2446·20	Manganese,	fused,	108·72
Cerium,	fused globules,	2446·20	Molybdenum,		54·31
Lithium,	globules,	2228·76	Magnesium,	wire and tape,	45·30
Lithium,	wire,	2035·44	Potassium,	globules,	22·65
Erbium,	fused,	1671·57	Silver,		18·60
Didymium,	fused,	1630·08	Aluminum,	bar,	16·30
Strontium,	electrolytic.	1576·44	Cobalt,	cubes,	12·68
Indium,	pure,	1522·08	Nickel,	cubes,	3·80
Ruthenium,		1304·64	Cadmium,		3·26
Columbium,	fused,	1215·28	Sodium,		1·36
Rhodium,		1032·84	Bismuth,	crude,	1·95
Barium,	electrolytic,	924·12	Mercury,		1·00
Thallium,		738·30	Antimony,		·36
Osmium		652·32	Tin,	recent quotations,	·25
Palladium,		498·30	Copper,	" "	·22
Iridium,		466·59	Arsenic,	" "	·15
Uranium,		434·88	Zinc,	" "	·10
Gold,		297·72	Lead,	" "	·06
Titanium,	fused,	229·80	Iron,	" "	·01½

DECISIONS OF THE COURTS.

United States Circuit Court—District of Massachusetts.

PATENT ELEVATOR.—OTIS TUFTS *et al.* *vs.* THE BOSTON MACHINE COMPANY.

[In equity.—Before Shepley, Cir. J.—January, 1875.]

Shepley, J.:

This is a bill in equity brought for alleged infringement of letters patent issued to Otis Tufts, dated August 9, 1859, and extended seven years, for improvements in hoisting apparatus, and adapting that apparatus for use as a passenger elevator for carrying persons to and from the different stories in hotels and other buildings; and also of letters patent dated May 28, 1861, for improvement in the mode of suspending and operating the elevator; also, for infringement of letters patent dated December 11, 1866, for improvements in the mode of adjusting the length and tension of the ropes of an elevator; and of letters patent dated December 11, 1866, for an improvement in elevator guides. All of these patents were duly assigned to complainants.

The twelfth claim in the patent of August 9, 1859, No. 25,061, is the one on which the infringement is claimed, and is as follows:

"I claim passing the shipping rods and the cord or rod that operates the friction brake through the car or platform, for the object and purposes set forth."

The shipping rods are described in the specification as passing up through the car the whole hight of the building and operating a shipper, by which the driving belt is shipped from a fast to a loose pulley when the power is to be thrown off. The cord is also described as passing down through the car or platform, so as to be accessible within the car, which operates to apply a counterpoise spring, so as to put on a friction-strap brake, its office being to check or perfectly stop the descending motion of the car at the will of any person within the car or on the gallery.

The great advantage (claimed) of running the shipping rods and the cord or rod up through the car itself is that they are thus rendered accessible to the conductor, or any person within the car, without incurring the danger of protruding the hand or arms beyond the same while in motion.

If the twelfth claim be construed broadly as a claim for passing any rod or cord, by means of which the appropriate mechanism is operated to move the car up and down, or hold it at rest, *through the car or platform*, instead of outside the car or platform, it is void for want of novelty.

George V. Hecker has, in his flour mill in Cherry street, New York, an elevator which was put in twenty years ago, and which has been in successful operation since that time. A chain passed through the roof and floor of the cage or car, which operated upon a friction clutch and a brake. The conductor or operator within the car could, by means of this chain, operate the shipping apparatus and the brake without incurring the danger of protruding the hand or arms beyond the car while in motion. This chain is connected with a brake in such a manner that the brake could be thrown off by pulling upon the chain, or put on by relaxing the pull upon the chain, a weight then causing the brake to produce friction on the friction pulley. The pull upon the chain, by raising the weight, first relieved the friction of the brake, and then threw into gear a friction clutch, and the car ascended by the force of the motor applied through the friction clutch. When it was desired to stop, the pull upon the chain was relaxed, and the weight threw the clutch out of connection and the cage stopped, held in place by the brake. When it was desired to descend, a slight pull was made upon the chain, sufficient to relax the pressure upon the brake, but not to throw the friction clutch into gear. The car then descended under control of the brake, by force of gravity, at a speed dependent upon the will of the operator who controlled the brake. Within the car was a lever with one long and two short arms, with a friction pulley on each of the short arms, which device was for the purpose of making necessary pulls upon the chain which passed through the inside of the car. The friction clutch is a well known substitute for a shaft with a fast and loose pulley, a belt, and a belt shipper.

It is manifest, therefore, that, in view of the state of the art, the twelfth claim in the patent can only be sustained by giving to it a much narrower construction than the one claimed for it, and one strictly in accordance with the language of the claim, namely:

Passing *the* shipping cords *and* the cord or rope that operates the friction brake through the car and platform, for the objects and purposes set forth.

The defendants do not infringe the twelfth claim thus construed, or any other claim of the patent of August 9, 1859.

Infringement is also alleged on the first and second claims of the patent of May 28, 1861, which are as follows:

"1. Constructing an elevator or hoisting apparatus with a series of two or more hoisting ropes or chains having independent attachments, and winding simultaneously upon the hoisting drum for greater safety, substantially as described.

2. Equalizing the strain upon the series of ropes or chains of my improved elevator or hoisting machine by automatic adjustment, substantially as described."

To construct "an elevator or hoisting apparatus with a series of two or more hoisting ropes or chains having independent attachments, and winding simultaneously upon the hoisting drum," was not new at the date of this patent. Letters patent of Great Britain to Frederick Levick and Joseph Fieldhouse, sealed January 13, 1854, describe a hoisting car or carriage with two hoisting ropes wound around the same spirally grooved drum. The ends of both of these ropes are attached to a connecting chain, which passes under a pulley attached to the top of the car. Another chain is attached to the first-described chain in such a manner that the chain surrounds the pulley. If one breaks, the other, with the chain, forms a loop around the pulley, and sustains the car. The second chain converts the attachment into an independent attachment of each rope, and, when one rope breaks, the other rope will continue to sustain the weight of the car. Mr. Renwick, the expert, correctly states that—

The ropes act precisely as if they were attached to the two ends of a horizontal lever whose center, upon which it could turn, was secured to the top of the car.

In the patent of 1861 the patentee, Tufts, says:

I do not confine myself to the precise method herein described of effecting the automatic adjustment of the strain upon the hoisting ropes, as I sometimes accomplish the same by a rocking lever, when two ropes are used.

It is plain that, in the Levick and Fieldhouse elevator, the two ropes, when intact, have equal strain upon them, and that, if one of the ropes should break, the weight of the car would be supported by the other rope. If the chain should break under the pulley the car would fall, as it would in the form last described or the Tufts elevator, if the attachment to the car at the center of the rocking lever should fail.

It is contended that the purpose of the two ropes in the Levick and Fieldhouse machine was to keep the cage in the center of the shaft, and that, therefore, the Levick and Fieldhouse patent does not anticipate the first claim in the patent of 1861. The answer to this is, first, that, whether they were placed there for the purpose of greater safety or not, they effected that result; and, secondly, that the patentees evidently contemplated that as one of the beneficial results to be attained by the use of two ropes instead of one, as there is no conceivable use for the cross chain before described, except in case of the breakage of one rope, to form a loop around the pulley, thus attaching the surviving rope to the car.

In the elevator which was placed in the mill of the Parsons Paper Company, at Holyoke, Massachusetts, in 1856, there were two hoisting ropes, having independent attachments to opposite arms of a rocking lever; they jointly and equally took the strain of the weight of the car, and each rope was sufficient to sustain the load put upon the machine. This elevator has been in constant use, and when one rope has broken the elevator has been worked several days with the remaining rope. The ropes in the Holyoke elevator did not, it is true, wind around a drum, but were passed around a series of pulleys, and the free ends of the ropes were attached to counterpoise weights, but these two means of winding up a rope to which a weight is attached are well known substitutes for each other.

Without adverting to the other patents which have been introduced in evidence, and relied upon in defence in this branch of the case, enough has been stated to show that the first claim of the patent of 1861 is void for want of novelty.

The second claim in this patent, namely, "equalizing the strain upon the series of ropes or chains of my improved elevator or hoisting machine by automatic adjustment, substantially as described," can only be construed as a claim for the described means of performing this function, and for well known substitutes for or equivalents of those described means. The means the patentee describes are three. One of those modes is by means of a rocking lever, or system of rocking levers, to the ends of which the suspensory ropes are attached. The Holyoke elevator and the Levick and Fieldhouse elevator both anticipate this claim. One had a rocking lever, and the other had a device which operated in the same way and produced the same result. If the claim is valid, defendants are not proved to have infringed it, for there is no evidence in the record tending to show that the contrivance used by the defendants—of a series of pistons fitting into a set of cylinders with connecting pipes, the cylinders being filled with an incompressible fluid—were, at the date of the patent, known substitutes for either of the means of adjustment described in the patent.

The patent of December 11, 1866, No. 60,441, so far as the second claim concerned, which is the one alleged to be infringed, relates to "mean for manipulating relative adjustment within reasonable limits of the series of ropes or chains, which are independently attached to the winding drum and to the car of the elevator, so that an equal degree, or very nearly equal degree, of tension can be had upon each rope or chain of the series, by proper attention or manipulation on the part of the party having such elevator in charge."

The patentee states in his specification that considerations of saving in the first cost of construction render it desirable in many instances to substitute for an automatic adjustment of the ropes or chains a means for adjusting them from time to time, as occasion may require; in other words, that the means of manipulatory adjustment in the patent No. 60,441 were intended as a substitute or alternative means for the automatic adjustment described in the patent of May 28, 1861, No. 32,441. The defendants have put into their elevators means of mechanical manipulatory adjustment, but they do not perform the function described by Tufts as a substitute for the automatic adjustment, because the tension on the ropes or chains cannot be varied by any manipulation of the nuts. Owing to the presence of the equalizer, the means of automatic adjustment in the defendant's elevator, the nuts or the stirrups may be screwed up or down to their fullest extent on any rope, without any variation of the tension on that or any other rope. As defendants do not infringe, it is not necessary to consider the question of novelty of this claim.

The patent of December 11, 1866, relates to means by which an elevator is so guided as to prevent the sway thereof, and the noise consequent upon contact with the ways by which the elevator is guided. The claim is as follows:

I claim combining the suspended car of an elevator with the ways or rails which confine it, by means of guides kept by springs constantly in contact with said ways or rails, when said guides are so arranged as to be capable of motion toward and from the rails.

In the provisional specification, filed April 6, 1858, in the office of the Commissioner of Patents for Great Britain, accompanying the petition of Louis Tétar Van Elven for a patent, which did not proceed to the great seal, but which specification was printed by Eyre & Spottiswoode, is a clear and accurate description, which contains all the features of this claim. Respondents' exhibit No. 13 is a model of the device described in the Van Elven specification. It fully anticipates every feature of this claim.

Complainant's bill dismissed.

[*James B. Robb*, for complainants.
Causten Browne, for defendants.]

Recent American and Foreign Patents.

Improved Lint Room Floor.

John N. Stitt, Sardis, Miss.—This lint floor consists of small rods arranged with spaces between, and on joists sufficiently wide to spring a little by the weight of persons walking on the floor—the object being to allow the dust which settles down to the floor to escape, and thus avoid soiling some of the cotton which comes in contact with the floor.

Improved Cultivator.

Edward Nauman, Uniontown, Ohio.—The cultivator is supported at its front end by a small wheel, whose position or angle to the frame may be changed at will by means of a rod which extends back and rests on a notched bar connecting the handles, whereby the wheel may be held locked in any desired position. This construction enables the plows to be held up to the row of plants, when plowing upon inclined ground, by the action of the wheel.

Improved Gas Generator.

James C. Mitchell, Lancaster, N. H.—This invention relates to certain improvements in the manufacture of illuminating gas, designed to utilize any kind of fuel for the production of the gas, and applicable to limited manufacture, as for private families, etc. It consists in a retort placed within a furnace, or a common stove, if desired, and having an airtight door of peculiar construction, and a communication direct with the furnace, by means of which construction the gaseous contents of the retort may be drawn into the furnace and burned when the airtight door is to be opened for drawing and recharging the retort. It also consists in the peculiar construction and arrangement of the tops of the purifiers and an airtight door to the retort, and the combination with the feed pipe to the gas holder of a ball valve to prevent back pressure.

Improved Plow.

Henry Krog, Sr., Washington, Mo.—The connecting ends of the share landside bar, and seat are welded together, while the outer ends of plates on the share and bar are riveted or bolted together.

Improved Hoop Fastening.

William Spalding, Petersburg, Mich.—This consists of a triangular plate clip, which covers the outer end of the hoop. It has points, which are passed through the hoop and clinched on the inside.

Improved Saw Setting Device.

Lewis A. Greely, Elmira, Ohio.—This is a block of steel, on the working side of which is a projecting face, a fulcrum, and a set screw, which latter passes through the gage and is turned or graduated from the back side. The screw may be turned so as to project more or less, as may be desired, according to the degree of set of the teeth. The gage is held against the saw with the hand in such a manner that the set screw rests or bears against the saw, and the fulcrum against the base of the tooth. The tooth is then bent over the fulcrum until the point touches the face, which is accomplished by means of a hammer and anvil or screw wrench.

Improved Means for Raising Water into Railroad Tanks.

Tyree Rodes, Wales Station, Tenn., assignor to himself and T. A Atchison, same place.—The invention consists of a grapple attachment, which is hinged to the cow catcher beam, and used at either side of the locomotive, the grapple taking hold of a wire rope stretched on running gear along the track, and operating thereby the tank pump, until a post near the end of running gear strikes the clamping lever and drops the wire rope.

Improved Veneer Cutting Machine.

Curtis T. Fairchild, Hartfield, N. Y., assignor to Burrell, Ives & Co.—The improvement in this machine is a presser roller, arranged for adjustment independently of the knife, but feeding along with it. It bears upon the log so far above the said knife that, before the edge of the part split off comes in contact with the knife, and is subjected to the lifting force thereof, the said presser roller will force the said piece down upon the main body of the log so hard that it will overcome the force of the knife, and be thereby prevented from being forced off.

Improved Folding Seat for Horse Cars.

Cevedra B. Sheldon, New York city.—This consists of an extra seat contrived to be carried under the main seat when not required for use, and to be readily shifted into position for use above and in front of the main seat on a jointed and folding standard, rising up so that it will project from under the main seat between the passengers sitting on it without inconvenience to them. The extra seat is so jointed to the top of the standard that it turns up edgewise at right angles to the longitudinal direction of the seat for affording the necessary freedom to the sitters on the main seat to rise up or sit down. The object is to afford seats which may be temporarily brought into use when more persons are in the car than can be seated on the ordinary seats.

Improved Registering Machine.

Collins M. Cady, Peninsula, Ohio.—A lever has on its end a stub, upon which the measure is placed to depress that end of the lever. The other end of the lever operates a pawl by means of a connecting bar. The tallying mechanism consists of two ratchet wheels, a forked plate, an eccentric, a dial, and hands, and a central post, with which post the inner ratchet wheel and eccentric and unit hand revolve. The rim of the eccentric bears against the fork, and oscillates the plate, and at every revolution of the inner ratchet it throws a pawl which is attached to the forked plate into communication with an outer ratchet wheel, and turns that wheel one tooth. The movement of the ratchet is indicated on the dial, one hand for each ratchet, one being carried by the central post and the other hand by the outer ratchet.

Improved Rotary Hair Brush.

William G. Nutsford and William Glasgow, Chicago, Ill.—The invention relates to rotary hair brushes which are operated by hand; and consists in the construction of the frame and parts connected therewith, so that the brush has full play as to hight, while it may be turned and revolved in any position to be applied to all parts of the head.

Improved Log Turner.

Charles P. McWane, Dublin, Va.—The device consists particularly in the arrangement of the rope-winding shaft parallel to the ways on which the log carriage travels, and of the saw shaft at right angles thereto, and of the means for connecting the two shafts to cause their simultaneous rotation.

Improved Graining Roller.

William H. Burns, Chicago, Ill.—The invention consists of a movable shoulder of the roller below the flexible transfer belt that is stretched by suitable mechanism over shoulder and roller, for the purpose of adjusting the circumference of the roller, from shoulder edge to stationary roller edge, to the exact width or size of the panel.

Improved Harrow.

Samuel G. Jones, Mowcaqua, Ill., assignor to himself and James M. Jacobs, of same place.—The harrow has wings which may be swung closer or wider apart, as may be required for different work, also spreaders governed by adjustable cross bars.

Improved Motive Power.

Philip B. Greene, Centerville, Iowa.—This invention consists of a circular platform fixed to tilt on a center pivot by the weight of a horse, and a heavy roller, which he draws around a track at the margin of the upper side, to the under side of which platform are attached a number of hanging cam plates, which by rising and falling with the platform actuate pawls, which give continuous rotary motion to a vertical shaft by means of a ratchet wheel on it, in which the pawls work in succession as the platform is depressed and raised.

Improved Windmill.

Edward Dewald, Coyville, Kan.—The connection of a governor with hinged wings produces a continuous adjusting of the same to the velocity of the wind, and keeps up a uniform speed of the wheel, forming a sensitive self-regulating mechanism for windmills.

Improved Safety Attachment for Pocket Books.

Thaddeus Potter, Jackson, Miss.—Devices are provided whereby books are swung out and engaged in the lining of the garment, and, while thus engaged, guard against loss or theft of the book. By drawing up the slide the hooks are entirely disengaged and the book released from the pocket.

Improved Wall Paper Exhibitor.

William H. Hazzard, Easton, Pa.—This is an improved device for exhibiting wall paper, which avoids the necessity of constantly unrolling and rolling up the rolls of the paper, and the consequent injury to it in exhibiting it to customers.

Improved Weighing Scales.

Henry M. Weaver, Mansfield, Ohio.—The invention consists in the direct application of the platform-carrying and weight-supporting knife edges to separate weights of different proportions. These weights are jointed by arms and pivot rod, so that the result is obtained of allowing the object to be weighed being placed upon any part of the platform; and also the weights, having to each other quicker and slower oscillations, tend to stop each other, and thus bring the index sooner to a rest. The casing is provided with an adjustable device for setting the index to the zero point of the stationary dial. To one or each of the weights is attached one or more smaller weights, which, being adjustable, can be used to increase or decrease the capacity of the scale, and also adapt it to any given dial plate.

Improved Clasp for Uniting Webs of Cloth for Japanning.

Benjamin Atha, Newark, N. J.—The two ends to be connected are laid across a bar on the side opening into grooves, and pressed down at one edge into the grooves at one end of the bar. A key is then inserted over them, and driven along to the other end, drawing the cloth ahead of it, and securely binding it in. The unfastening is instantly effected by pulling out the key.

Improved Horse Hay Fork.

Thomas M. Edwards, East Hampton, N. Y.—This invention is an improvement in the class of horse hay forks wherein the hinged prongs are connected with the sliding bar, to which the hoisting rope is attached. In the sliding bar is formed a slot, in such a position that, when the bar is pushed fully down, the end of a spring pawl will enter it, and thus lock the bar and stock together.

Improved Cupola Furnace.

James Blakeney, Springfield, Ohio.—The tweer is composed of a circular flat plate, with curved chutes and a covering plate. These plates are made in sections of suitable length for convenience in handling and for strength, and built into the wall of the cupola, the chutes being inclined relatively to the direction in which the air is blown into it to arrest the circular motion, and direct it into the center of the cupola. A case extends around the cupola, and incloses the space in which the air is conducted to the tweer. The bottom of this chamber is made a little irregular to form hollows at suitable intervals, to cause the metal to flow to escape openings in case it overflows through the tweer. The openings will be closed with fusible plugs of lead, to be melted out by the molten metal.

Improved Safety Seat for Harvesters.

William E. Mattison, New Brunswick, N. J., assignor to William E. Mattison and Edwin Gulick, of same place.—This invention is an improved safety seat for reapers and mowers, so constructed that, should the driver be thrown from or leave his seat, the mechanism that drives the cutters will be thrown out of gear, and the cutters will cease to vibrate, so as to guard against the danger of his being cut by the cutters should he be thrown upon or in front of said knives, or should the machine be started while he is in front of them. The invention consists in shoulders formed upon, and a foot rest attached to, the connecting bar, in combination with the said bar, a bent lever, the bar, the seat, the springs, the platform, and shifting lever; and by this construction, the weight of the driver's feet will hold the bar locked and the mechanism in gear, even should the driver be jolted up from the seat; but should he be thrown from or leave the machine, the slightest jar of the machine will throw the cutting mechanism out of gear.

Improved Steam Cylinder for Cotton Press.

John F. Taylor, Charleston, S. C.—This invention relates to certain improvements in single acting steam cylinders, designed to operate the toggle arms of a cotton press; and it consists in a cylinder having at the top, near the end of the stroke of the piston and upon the inner periphery, a series of recesses of a greater length than the width of the piston; and also upon the same level a series of holes communicating with the outer air, which admit the air to fill the space above the piston on the downward stroke, and allow the escape of the same upon the upward stroke, the said recesses serving to equalize the steam upon both sides of the piston when the latter is upon the same, to break the momentum; and the air holes, being closed when the piston is on the recesses, coöperate with said recess to assist in breaking the momentum, by forming in the top of the cylinder an air cushion.

Improved Apparatus for Measuring Liquids.

Emile E. P. Clausolles, Barcelona, Spain.—This invention relates to certain improvements in meters or apparatus for measuring liquids, also adapted to be used as an engine or force pump. It consists of three or more lantern bellows, constructed of thin annular disks of metal, which said bellows operate successively upon the arms of an elbow lever, so as to cause the end of the main arm or central shaft of said lever to revolve in an orbit and operate a valve, which renders the action of the apparatus automatic. The top of the central shaft is secured by a ball and socket joint, and to the top of the same is attached a stud which, by engaging with suitable gearing, moves the index hand of the registering devices.

Improved Car Coupling.

Belton Mickle, Holly Springs, Miss.—This invention relates to certain improvements in car couplings; and it consists in the combination of a gravity catch having a slotted hole, through which a transverse pin passes to support it, and a drawbar having a central longitudinal slot in which the catch swings, and open recesses upon each side of said slot, in which the projecting ends of the transverse pin are supported. By means of this arrangement, the catch readily adjusts itself to the vibrations of the cars, and may be easily and quickly detached when desired.

Improved Animal Poke.

Henry Walton, Jesup, Iowa.—This invention relates to certain improvements in animal pokes, or devices to be attached to unruly cattle to prevent them from breaking through fences, etc. It consists in a bar having at its lower end a ring to be fastened in the animal's nose, and at the upper end a projecting stem or tongue which takes in the fence when the animal attempts to break through, and pulls the ring in the nose. The said bar is extended a sufficient distance above the animal's head, and is prevented from turning by a crossbar resting upon the face, the main longitudinal bar being held in position against lateral displacement by rings which pass over the horns, and are attached to said bar by adjustable rods.

Improved Calendar.

David J. Miller, Santa Fé, New Mex.—This invention relates to certain improvements in calendars; and it consists in a system of movable pegs, in combination with the attachment hereinafter explained, marked and arranged in headings, columns, and rows, the whole constructed in a block of wood or other suitable material, headed with the year current and divided into twelve divisions, each representing and headed with the name of a month, and each month divided into seven columns of six pegs, the columns headed with the names of the day of the week, and the pegs marked with the numbers of the days of the month and of the days of the year in their order: each date peg having attached to it, on the back or immediately adjoining, a sliding slip or piece of metal or other material also marked, and each being susceptible of bearing also other marks or indicators, as of celestial phenomena and other occurrences capable of easy visible representation.

Improved Cultivator.

Gershom Wilkinson, Quincy, Ohio.—By suitable construction, should the plows strike an obstruction, the upper ends of the standards will be forced forward, raising a lever and allowing the plows to swing back, so as to pass the obstruction. The plows may be adjusted wider apart and closer together by adjusting the positions of bars. To the outer bar of each pair is attached a lever, upon which is placed a slotted plate. The plates have hooks upon their side edges, turned in opposite directions. When the plates are in position, by loosening the clamping nut they may be raised to support the plows farther from the ground, and, by inverting the plates, which brings the other hooks into working position, they may be lowered to support the plows at a less distance from the ground.

Improved Adjustable Sack Holder.

Henry W. Clark, Red Bluff, Cal.—A slotted upright has cleats on the back, flush with the sides of the slot. An arm adjustable on the upright has a spiral spring on its upper side. The under side of another arm, constructed and made adjustable in a similar manner, rests on the spring. A semicircular metallic spring, attached to the lower arm, holds the bag. The arms are adjusted to suit the length of the bag, and so that the bottom of the empty bag will nearly touch the bed. While the bag is being filled, the weight will bear it down to the bed, while the spiral spring will allow it to settle.

Improved Wedge for Splitting Rock, etc.

Thomas Cosbey, Fort Scott, Kan.—This invention consists of a metal wedge, whereof the middle portion is hollow or open from one of the tapered sides to the other, to dispense with certain portions of the metal of a solid wedge which are not needed, and thus to economize in the cost. The object is also to make the device lighter and more convenient to handle; and also to provide a hole by which it can be grasped by the fingers or by hooks when it has fallen into a deep cleft of a log or rock, from which it is very difficult to remove a solid wedge.

Improved Harrow.

Adolphus W. Davis, Dwight, Ill.—This improved harrow is so constructed as to adjust itself to uneven ground, and it will allow either of its sections to be raised from the ground without affecting the others.

Improved Process of Making Imitation Woods.

George V. Hann, New York city.—This is a process of making imitation woods by first graining a surface with a mixture of acetic acid, logwood, and iron oxide, and then staining with a mixture of shellac, alcohol, logwood, and red sanders.

Improved Convertible Rocking Chair and Swing.

Sigmund Feust, New York city.—This invention consists of a chair with hinged rocker and leg sections, which are capable of being rigidly applied as rockers for a chair or as side arms for a swing seat. Below the hinged seat of the chair is a box for the reception of the suspension cords attached to the frame of the chair, they being stored in such a manner within the receptacle as not to prevent the closing of the seat.

Improved Bed Lounge.

Abraham Morris, New York city.—This relates to an improved bed lounge, which is provided with a side or guard rail and legs, that are, simultaneously with the opening or folding of the section, carried into the required position. The invention consists of a side or guard rail pivoted to the extended legs swinging therewith. The guard rail supports also, by guide groove in connection with a face strip of the main head piece, the detachable head piece of the folding section.

Improved Wrench.

Thomas F. Dunn, Saccarappa, Me.—This consists in combining two or more wrenches by means of a longitudinal slot, in one. By this means, the lever on either of the wrenches is materially increased, and when one of the wrenches is placed endwise on the nut, the wrench, which is passed through the slot, may be used as a handle to obtain leverage.

Improved Cultivator.

Joseph C. Jenkins, Lebanon, Tenn., assignor to himself and James G. Jolley, same place.—This is a combination, with two cultivators or gang plows, of a medium coupling, consisting of blocks and a pivoted bow. This gives the plows an opportunity to accommodate themselves to the movements of the horses, and enables the plowman readily to turn or lift each frame laterally, so as to avoid stones or stumps.

Improved Adjustable Handle for Harrows.

Samuel D. Riegel, Adelphi, Ohio.—This improved handle for harrows is so constructed that it may be instantly adjusted to enable any desired part of the harrow to be raised from the ground to pass obstructions, or to clear the harrow of rubbish, and to enable the harrow to be held in or to the right or left of the line of draft.

Improved Compound for Preserving Fish.

Henry Seliman, Hoboken, N. J., and Herman Reessing and Julius Wolff, New York city.—The fish are preserved and at the same time flavored by being packed with a compound of vinegar, allspice, pepper, onions, horseradish, bay leaves, cloves, ginger, coriander seed, Chili pepper, and capers.

Improved Button.

William Hornich, Newark, N. J.—This invention consists of a button which is made with a loop-shaped re-enforcing wire, retained by the metallic shells of the same, for strengthening the fastening fabric.

Improved Door Check.

Horace B. Church, Jefferson City, Mo.—This invention is an improvement in that class of door checks which are formed of a sliding spring bolt and an elastic block secured in a socket in its outer end. The socket for the elastic block is separate from the sliding bolt, and both are connected together by means of an arm which extends downward and holds the socket horizontal. A smaller and cheaper bolt and case is thus employed, and the socket piece may have any required size of friction surface without necessitating any corresponding change in size of the bolt.

Improved King Bolt for Wagons.

William Truax, Hamilton, Mich.—The king bolt is made without a head, and is placed in a hole that passes through the axle tree, sand board, and bolster. The lower end of the king bolt rests upon a plate fitted to the lower side of the axle tree, and secured in place by bolts that fasten the sand board to the said axle tree. By this construction the king bolt will be held securely in place, and, being made without a head, will not wear the bolster and the wagon box.

Improved Butter Package.

Cevedra B. Sheldon, New York city.—This invention consists of a wide hoop-shaped jacket of non-conducting material, pressed on the tapering metal body of the package, both for re-enforcing it as to strength, so that light thin metal may be used, and for protecting the metal from the rays of the sun while the packages are in transportation. The bottom is made of stamped sheet metal, and has a flange turned up outside of the lower end of the body, serving for a strengthening band to the thin substance of the body, also for soldering to the body.

Improved Carbureter.

Edward J. Daschbach, Pittsburgh, Pa.—This invention consists of a carbureting chamber surrounded by a feed tank, in which the gasoline or other hydrocarbon substance is maintained above the feed passage into the carbureter by atmospheric pressure, so that a regular automatic feed is obtained by the oil in the carbureter, and the carbureter is provided with an inlet pipe projecting below the oil inlet.

Improved Windmill.

Jacob D. Christie, Schrallenburg, N. J.—The invention consists of the adjustment of a wheel shaft having a hinged supplementary vane, on a quadrantal turntable, to any angle with the main vane. The wheel is provided with adjustable weights of sliding rods, that act on a brake mechanism of the shaft, to change the position of the wheel shaft toward the main vane. The separate adjustability of the wheel and shaft from the main vane, in connection with the regulating mechanism of the wheel, is claimed to give a uniform motion and even speed at varying velocity of the wind, and admits, also, the exact setting of the mill to the power required for certain purposes.

Improved Car Coupling.

John M. Marlin, Willett, Pa.—This consists of pivoted and spring-acted side bars, that are guided by rigid top and bottom drawhead bars, to retain on their flanged and concaved front ends the coupling pin, until they are forced apart by the entering link, for dropping the link for coupling. The link is wider at the central part, to prevent its entering too far into the drawhead.

Improved Street Car Coupling.

Heinrich Krüger, Jr., New York city.—This is a coupling hook for street cars, by which the draft bar and single tree are supported at such hight that the injuring or entangling of the legs of the horses on the stopping of the car is prevented without changing the point and direction of draft. The invention consists of a braced and spring-acted lever that is pivoted to supports of the car bottom frame, and carried up against the dashboard, so that the coupling hook and draft bar are raised with the same while being lowered by the strain thereon.

Improved Shelving for Stores.

Henry T. Bestor, San Francisco, Cal.—In this improved construction of store shelving, the carrying girder is set back, so that the front finish comes flush with the front of the supporting posts, to allow of metal bars being suspended on the face of the finish for the intermediate support of the shelves, and so that covering columns may be applied in a simple way to hide the rod.

Improved Car Coupling.

John Q. A. Young and James D. Young, Cedar Mill, Oregon.—This invention relates to improvements on the car coupling of H. E. Smith, patented August 25, 1874. The invention consists of a bottom recessed drawhead, with jaw-shaped front end, and of an interior horizontally pivoted lower jaw, that lock the enlarged head of the coupling pin. A cam on the lateral shaft of the uncoupling lever binds on a rear swell of the lower jaw, for securely locking the coupling link, the shaft and cam being introduced to the cavity of the drawhead by a corresponding side slot.

Improved Bale Tie.

Henry J. Wright, Society Hill, S. C.—This invention relates to the construction of ties for baling cotton and other articles, and consists of a tie made of two parts, to one of which the band is attached, which lock together and tie the band.

Improved Egg Box.

Othello Sutphen, Albany, N. Y.—This is a spring-suspended egg box, having guide slots, in combination with pivot pins. The pins serve as guides and pivots for the different positions of the egg box, so that an easy vertical and side motion is allowed to the same.

Notes & Queries

A. K. B. will find a recipe for solder for gun barrels on p. 353, vol. 27.—R. S. will find that galvanizing wrought iron is described on p. 346, vol. 31.—A. J. and others will find directions for etching on glass on p. 409, vol. 31.—S. J. F. will find directions for modeling in clay, wax, etc., on p. 58, vol. 24.—S. N. will find directions for making gravel walks on p. 50, vol. 32.—R. J. will find directions for filling and polishing black walnut work on pp. 315, vol. 30, and 347, vol. 31.

(1) W. O. H. says: A friend claims that, if a balloon could be made so as to sustain the pressure from the outside, and the air were pumped out so as to form a vacuum on the inside, that it would rise. I claim that it would not. Who is right? A. Your friend.

(2) A. J. S. says: Are you aware of any one who has ever actually discovered perpetual motion? If it has not yet been discovered or revealed, do you really believe that perpetual motion, pure and simple, would be of any pecuniary advantage to its discoverer? A. No one has ever discovered perpetual motion. You can judge of the probability of such a discovery if you bear in mind that the principle involved is the same as when one tries to lift oneself in a tub, by pulling at the handles. Some of the perpetual motion inventors put cog wheels or levers between their hands and the tub handles. But the result is the same. It is always a perpetual no go. No reward has been offered.

(3) G. L. L. says: What use, if any, can be made of old photographic collodion? A. If the solvents have not already evaporated, and the solution contains no volatile acids, the ether and alcohol may be readily removed by subjecting the solution to distillation in a glass retort over a water bath, with a very gentle heat. The solution, however, should not be allowed to evaporate to dryness.

(4) H. M. asks: How can I bleach shellac? A. By filtration of the solution over animal charcoal.

What are the average weights of a cubic inch of copper and tin, respectively? A. Copper about 0·32 lb., tin about 0·217 lb.

How is the inside area of a cylinder found? A. To find the surface of a cylinder: (circumference of base×altitude)+twice the area of base. To find solid contents: Area of base×altitude.

(5) A. S. asks: Is there any solvent besides cyanide of potassium, for sulphide of copper? A. The sulphide of copper dissolves readily in strong *aqua fortis* (nitric acid) on application of heat.

(6) H. B. C. asks: What kind of a solution should I make to plate with tin, having tin as a positive electrode? A. Electro-metallurgists consider the sulphate to be the best solution for this purpose; but the reduction of tin by galvanism cannot be considered an advantageous process. The best method for tinning metallic surfaces is that of immersing them in a bath of molten tin, the surface of which is kept free from oxide by means of a layer of chloride of ammonium (sal ammoniac). An even and regular coating of the metal is thus obtained speedily and with little trouble.

(7) M. S. asks: 1. Are the oxygen and hydrogen, used in stereopticons, dangerous? A. They are explosive only when mixed and ignited. 2. Of what color are the screens that are used for the same purpose? A. White. 3. Are they painted or varnished? A. When intended to remain stationary, they are occasionally covered with an even coating of whiting with a little size.

(8) C. T. S. asks: What process will make ordinary white quartz crystals, resembling amethyst? A. Take borax 5 parts, saltpeter 5 parts, pearlash or fixed alkaline salt, purified with niter, 33 parts, pure white sand, cleansed by washing, 57 parts. First reduce the sand in a glass or flint mortar to a fine powder, then add the other ingredients and grind them well together. To 10 lbs. of the above add 1½ ozs. of manganese oxide and 1 drachm of zaffre. Melt in a small clay crucible, and cover the surface of the crystal by immersion.

(9) H. asks: Of what size, and of what cheap material, should a hot air balloon be made to raise a weight of 150 lbs.? A. A closely woven variety of light cambric is best for this purpose. It is not customary (where the proper material is used) in this style of balloon to use any varnish whatever. If the case requires it, however, a light solution of boiled linseed oil in turpentine may be used.

(10) G. W. N. asks: Which is the positive pole and which the negative, in a battery? A. In all forms of battery, the binding screw attached to the zinc plate is always negative, and the connection of the opposing element, whether it be copper, carbon, or platinum, is always positive. If a small mariner's compass be placed immediately under a copper wire running north and south, (that is, parallel with the needle of the compass when in a state of rest and not subject to any disturbing influence), over which a current is passing from north to south, the needle of the instrument will immediately be deflected, its north pole moving to the east, and its south pole to the west. If the current be reversed, the needle will move in the opposite direction.

There is a boat fastened to a dock by a rope. P. says that a man standing in the boat will not be obliged to exert so much force to pull the boat to the dock, as one who stands in the dock and pulls the boat toward him. N. says the man will have to exert the same amount of force in both cases Who is right? A. N.

(11) D. A. C. asks: Is there an agent which will bleach or clarify, by burning or fumigation, vegetable substances? I want an agent that will bleach tobacco in the process of curing or drying the plant. Sulphur will do it to a certain extent, but it imparts an odor which injures its market value. A. Tobacco may be readily bleached by means of either sulphurous acid or chlorine: but in the operation it undergoes a partial decomposition, new salts being formed. This destroys the properties for which the tobacco is most valued.

(12) J. H. L. asks: For some time past I have been trying to bleach what is called *cera de Campeche*, a wax made by a large bee near the Pacific coast in the neighborhood of Autian; it is of a dark yellow color and a strong smell; it becomes quite soft and sticky by working with the hands. How can I do this? A. Beeswax may be bleached by nitric acid; but chlorine, though it destroys the color, cannot be employed for this purpose with advantage, for it was observed by Gay Lussac that a substitution of chlorine for a portion of the hydrogen occurs under these circumstances. When candles made from such wax are burned, irritating vapors of hydrochloric acid are evolved. Beeswax has been commonly bleached by exposing it in thin layers to the action of sunlight for some time. Try the action of a solution of chlorine gas in water, or, what is perhaps less objectionable, a solution of chloride of lime (bleaching powder).

(13) A. P. asks: Is there any magnetic needle or other instrument that will show where to dig for water, and where springs exist? A. There is no such instrument in existence.

(14) C. K. asks: What degree of heat is acted upon and absorbed by a liquid, such as an oxyhydrocarbon oil, contained in an iron or copper vessel of about equal width to its depth, heated by live steam of about 40 lbs. pressure? A. As you fail to state the particular oil in question, we cannot give you its specific heat. The temperature of the oil would, in no case, be higher than the steam or hot water surrounding the vessel containing it. Whether the oil vessel were completely or only in part filled with the oil, the conditions being the same in both cases, the temperature would eventually mark nearly the same degree, although in the former case the expenditure of a larger amount of fuel would be required to accomplish such a result.

(15) J. E. H. asks: Is there any known way by which skippers in smoked meat can be destroyed without injury to the meat? A. Try the action of a small quantity of the iodate of calcium or salicylic acid.

(16) T. W. C. says: I have a friend who uses a process in which a quantity of water must be maintained at a temperature, near to but always above the freezing point. To procure this he uses considerable quantities of ice. Could the same effect be economically produced by the Carré freezing apparatus? A. Yes.

(17) A. B. C. and others ask: Which wheel of a truck slips in going around a curve, the inside or the outside one? A. This question is frequently asked by our correspondents, and is very fully answered by a writer in the *Railroad Gazette* as follows: That wheel will slip on which the pressure is the least. For a single truck with an equally distributed load, other things being equal, on a flat track (that is, one in which there is no super-elevation of the outer rail), the inside wheel will slip, for the following reasons: 1. Because the direction of the resultant of the weight and of the centrifugal force is more in the direction of the outer than of the inner wheel. 3. Because, on account of the parallelism of the axles and the play allowed the wheels, the flanges of the latter are against the outer rail and away from the inner one in the passage around the curve, and this is true whatever may be the speed. This brings the point of application of the resultant (corresponding to the loaded point on a beam) nearer the outer than the inner bearing. On a curve, the outer rail of which has been elevated for a given speed, at this speed the resultant above mentioned is perpendicular to the plane of the rails, and hence at that particular speed the first of these causes is inoperative, while the second, remaining in force, causes the inner wheel to slip as before. At any higher speed, the first cause again comes into play, and allows the inner wheel still greater facility for slipping, and the more so the higher the speed. On the other hand, for a speed less than that for which the rail was elevated, the centrifugal force, being diminished, brings the resultant more in the direction of the inner rail than before, and at some speed would make its direction such as to exactly counteract the effect of the second cause, and would thus render the wheels equally liable to slip. At less speeds the outer wheel would slip. In the case of a long train, the wheels at the ends are nearly in the condition of those of a single truck, while those near the middle, being drawn to the inner rail by the action of the forward and rear portions of the train, will sooner come into a condition in which the outer wheels will slip. In this, the coning of the wheels has been considered as a part of the elevation of the outer rail, either increasing or diminishing it as the flanges press against the outer or the inner rail.

(18) W. X. says: I have two ½ inch pipes, one glass and the other lead, which I wish to unite so that the joint will be neat and bear the pressure of a column of water fifteen feet in hight. In what way can they be best united? A. Use as a solder the following alloy, which fuses below the boiling point of water: Bismuth 2 parts, lead 1 part, tin 1 part.

(19) E. J. F. says: How can I cut fine edgings on paper, such as the borders on valentines or bouquet papers? A. These borders are stamped by a die cut in metal.

(20) H. P. O. asks: Please give me recipe for good and permanent red and black dyes wherewith I can dye cotton and linen thread? A. For red, use cochineal, lac dye, madder, or logwood with a tin mordant. For black, use logwood or galls with an iron mordant.

How can metal be cemented to glass? A. See p. 27, vol 30.

(21) C. A. F. asks: How can a silk fish line be made waterproof? A. Take 2 parts boiled oil, 1 part gold size, mix, shake well, and it is ready for use. Apply with a piece of flannel, let dry thoroughly, and apply another coat. Use 3 coats in all.

(22) C. S. W. asks: What is the best way of preparing starch for use on linen collars, etc.? A. Wheat starch is generally considered the best. It is made as follows: Steep wheat flour in water for a week, draw the liquor off, and wash the residue on a sieve; drain in perforated boxes, cut up into lumps, and dry in the air or on a stove.

(23) J. D. says: Please give me a recipe for wax for tracing designs in hair lines on zinc with a pen, which will protect the zinc from acid used to etch the design on the metal? A. If you use nitric acid, try a mixture of equal parts of asphaltum, Burgundy pitch, and beeswax; melt them in an earthen pipkin, stir well, and pour into cold water. Use warm.

(24) A. L. H. asks: What is a good method of cleaning tin, copper, brass, etc., without scratching the same? A. On tin, use potash lye and rub with a hard substance. On copper and brass, use spirit of tar.

(25) C. E. G. says: I claim, in arguing the merits of the Keely motor, that water is a spent substance, and cannot again produce power unless the equivalent is laid out on it. A. You are right.

(26) V. H. says: 1. On p. 74, vol. 28, you give correspondent K. W. a varnish for photo paper trays, consisting of a mixture of petroleum naphtha and paraffin. Can the varnish be applied to wooden trays? A. Yes. 2. How many parts of each ingredient should be used? A. Put in paraffin till the petroleum naphtha will dissolve no more.

(27) W. U. asks: What are the rules for calculating the permutations and combinations of numbers? A. The number of permutations of n things $=1\times2\times3$, etc., $\times(n-1)\times n$. The number of arrangements of m things, taken n in a set, $=m\times(m-1)\times(m-2)$ etc. $\times(m-n+1)$. The number of combinations of m things, taken n in a set $=$

$$\frac{m\times(m-1)\times(m-2)\text{ etc.}\times(m-n+1)}{1\times2\times3,\text{ etc.}\times(n-1)\times n.}$$

(28) L. H. R. says: I wish to know whether the following conjectures are probable: Scientists, in giving the hights of mountains, clouds, balloons, etc., say they are so many miles above the level of the sea. Is the level of the sea the same all over the surface of the earth? Is the surface of the ocean at each part of the globe at the same distance from the center of the earth? I think it would be so if there were no revolution of the earth around its axis; but since there is, the centrifugal force thereby produced would cause the looser particles (water) of the earth to be heaped up at the equator, making the level of the ocean at this part higher than at parts north and south of it. And further, in my opinion, the water would not only accumulate here, but would accumulate in proportion to its quantity or mass thereby making the Pacific Ocean of higher level than the Atlantic. Is this actually the case? A. If you measure the hight of the sea level by its distance from the earth's center, it is not the same everywhere, but is higher under the equator and lower at the poles. This is called the flattening of the earth, and is, in round numbers, $\frac{1}{300}$, which means that the polar axis is $\frac{1}{300}\times8{,}000$, or about 26, miles shorter than the equatorial diameter therefore the ocean's surface at the equator is 13 miles higher than at the poles, and the Mississippi river runs, in a certain sense, actually up hill. The hight of the mountains is always estimated from the nearest sea level. There are, besides this, other irregularities in the ocean level, of which we have treated elsewhere in this issue.

(29) J. C. W. asks: 1. If any one will look steadily for a short time at such an anemometer as is used by the United States Signal Corps, consisting essentially of hollow hemispheres, and will notice the direction in which the cups revolve, he may after a time apparently see the motion reversed, and the cups going in a direction exactly contrary to that in which they really move. A good position to take with reference to the anemometer is about 50 yards from it, and nearly up to the level or horizontal plane in which it moves. No doubt others have noticed the deception, as it is very apparent when once observed. A little perseverance in the effort may perhaps be necessary at first in order to perceive the change as it seems to be. A. This optical delusion has been often observed, and is simply caused be the difficulty of deciding which balls are the nearer. If we take the further off for the nearer, the motion of course appears reversed. The same thing may be observed in some windmills, when looked at by the edge of the arms. 2. Another illusion may be produced by a very simple experiment as follows Procure a round paper box about two or three inches in diameter, and, if its bottom does not bulge upward in the center, make it do so by pressing it in with the thumbs. Any sized round box of almost any material that is not affected by mercury will doubtless answer the purpose, but the kind mentioned is easily procured in the form of a large pill box or a collar box. After pressing the bottom inwards, as directed, pour into the box about one ounce weight of clean bright quicksilver, and give the box and contents a rotary motion until the quicksilver revolves rapidly around the circumference of the box in the depression caused by the convexity of the bottom and its junction with the perpendicular walls of the box. It is best to lay the box flat on a horizontal table while rotating it; and when the quicksilver seems to be

a revolving ring of liquid metal, let the box rest and watch the motion as the metal subsides. If there is about enough quicksilver to make a complete ring of the size of a goose quill (no precision needed), the liquid metal will seem obviously moving in a direction exactly opposite to its real course so as to deceive almost any beholder. The effect is due to the wavy motion of the quicksilver. A. The observation that the waves in mercury, when running in a rough channel, will propagate in a direction opposite to the current has been made before, but your simple manner of illustrating it deserves commendation.

(30) C. C. K. asks: Is there a south polar star similar to the north polar star? A. The north polar star in the Little Bear is not exactly over the north pole, but at a small distance. At the south pole the nearest star is 10° further off, and is in the constellation *Hydra*.

How do explorers tell the hights of mountains? A. Explorers as well as aeronauts measure the hights of mountains by means of the barometer, which gives tolerably reliable indications, as the air pressure decreases with the hight we ascend. Your way of telling the hight of clouds would be good if you only were sure that the cloud you see is the one from which the rain descends.

(31) M. H. R. says: It is a common observation among country people that a new moon is a wet or a dry one, according to the upright or horizontal position of its horns, and also that the moon affects the weather by its rising farther north or south than usual. Are not all of the changes of the moon, as to position in regard to itself or the earth, subject to a natural and, generally speaking, unerring law? A. The position of the horns of the moon depends on the relative position of moon and sun: if immediately after the noon, she shows herself vertically above the setting sun, the horns will be upright; if southward of the sun, the horns will be more nearly horizontal. That the moon affects the weather, causing an atmospheric tide wave as well as an ocean one, is undoubted; but the "unerring law" has not yet been discovered. Let us hope that the continued labors of the Weather Bureau will in time solve this problem, which is quite complex. The course of the moon is repeated, eclipses and all, every 21 years; but we have not the same weather every 21 years, which shows that other influences have to be taken in account, which observations in the future may reveal to us.

(32) J. H. asks: Can anything be added to ink made from nutgalls and sulphate of iron that will cause it to be black when first used, without injury to it? A. Try an addition of logwood.

(33) S. L. L. asks: Has the name carbonic acid recently been changed to carbonic dioxide? If so, why? A. Carbonic oxide is the compound formed by the combination of carbon with one equivalent of oxygen (CO). Carbonic acid is carbon in combination with two equivalents of oxygen (CO_2). The former is sometimes called the monoxide, and the latter the dioxide, of carbon.

(34) C. P. asks: I want to know the cheapest and simplest apparatus for compressing air in a receptacle of two quarts capacity. I would like to get the density of five or six atmospheres. A. Use an air pump.

(35) J. S. asks: Will paper keep a number of years, free from damage, even if placed in an excessively damp and dark hole, if it be inclosed in an airtight lead or glass case? A. If the paper be placed in a perfectly dry glass vessel, which is afterward hermetically sealed, it will be preserved indefinitely, or as long as the glass envelope remains intact.

(36) J. A. asks: Can I use a tin baking pan for a photographing bathing sink without injury to the chemicals? A. No.

(37) H. M. asks: Does the sun's heat shrink or expand seasoned wood? A. The expansion of the woody fibers by heat is more than counterbalanced by the shrinkage due to the consequent evaporation of the moisture and other bodies in the sap cells, therefore the wood, as a whole, shrinks.

(38) E. T. D. asks: Which is the most certain and quickest mode of discharging colors from cotton prints and delaines? A. Use chloride of lime.

(39) N. A. B. asks: How can I determine the electromotive force of a galvanic battery? A. To one not familiar with the science of electrical measurements, such determinations may be somewhat problematical. The following method of Poggendorff's, for the measurement of electromotive force, is perhaps the simplest and most comprehensive. In this method the more powerful battery, E, is joined up in circuit with a resistance coil, r, and the other battery, E', and a galvanometer are connected to the same coil, so that both batteries send a current through r in the same direction; by increasing the resistance of r it is easy either to make the current of E overpower that of E', or to obtain such an equilibrium that E shall remain inactive, and no current pass through the galvanometer in either direction. When this is effected, we have the following ratio: As the total resistance of E and r is to the resistance of r, so is the electromotive force of E to that of E', or E' = $E \times \frac{r}{E+r}$.

Can metallic silver be obtained by heating the nitrate in a crucible? A. Yes, by the addition of a small quantity of borax and resin.

(40) S. R. A. says, in answer to correspondents who ask how to destroy ants: Take a pasteboard box with a good lid, so that it can be made dark; cut a small hole near the bottom, put in about two tablespoonfuls of sugar, and set it away in some dark corner of the cupboard. Allow it to remain two or three days; take a quantity of hot water in a dish pan. You can guess the rest. Repeat the process until the supply of ants is exhausted. The same bait will last all the summer. Allow the ants to run out at the hole they entered, and then knock them off by striking the box, with the hand, a quick light blow.

(41) J. E. A. says, in answer to several correspondents: The reason why the screws now in use do not utilize the power is because the pitch of the screw doubles from the outside in nearing the shaft half way. If you turn a thread upon a rod a little more than half the altitude deep, then turn it down to one half the diameter, the pitch will be twice what it was before. If the pitch of the blades of a screw be at a greater angle than ⅛ of a circle, or 45°, it would impede its revolution. If a screw be 24 feet in diameter and the pitch 45° from the outside, then it would be an entire loss of power; if 22½°, there would be loss at all but the outside 6 feet. By setting the pitch in the inside or nearest the shaft, and twisting the blade from the outside to the required pitch, there would be no loss of power. Another principle is that the revolution of the screw and the pressure of the blades against the water would cause the water to flow away from the end of the blade; this would cause the screw to fall back, and not hold what it would naturally gain. This can be easily remedied by having the blade of full width at the end, and turning it over a few inches, making a rim on the back side of the blade: the water will then only flow away backwards from the side, as it should do.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

A. M. S.—No. 3 is a tannate of gelatin, and will doubtless answer all your requirements. It is probably made by steeping sheet gelatin in a solution of tannin, and then subjecting it to pressure. —F. W. P.—It is mica.

J. G. H. asks: How is the pretty imitation of pearl in ladies' dress buttons and parasol handles produced on tin or other metallic sheeting?—E.M. asks: How is a dry or magic shampooing powder made?—C. M. K. asks: Are the trimmings called Hamburg edgings made by machinery or by hand?

COMMUNICATIONS RECEIVED.

The Editor of the SCIENTIFIC AMERICAN acknowledges, with much pleasure, the receipt of original papers and contributions upon the following subjects:

On the Keely Motor. By W. J. J.
On the Spider's Web. By T. H.
On a Glass Oil Can. By A. B.
On Western Lands and Emigration. By T. E. L.
On Keely Transactions. By G. H.
On Boiler Incrustations. By B. B. S.
On Fishing Sinkers. By P. B. T.
On Large and Small Axles. By T. W. P.
On Gold Coinage. By J. R.
On Bee Culture. By L. E. C.

Also inquiries and answers from the following:
J. M. S.—J. C.—W. A. C.—F. W. D.—G. A. D.—M. E. —R. A. C.—J. S. C.—K. W. C.—J. W. M.—G. R. B.— F. N. M.—D. P. H.

HINTS TO CORRESPONDENTS.

Correspondents whose inquiries fail to appear should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them. The address of the writer should always be given.

Enquiries relating to patents, or to the patentability of inventions, assignments, etc., will not be published here. All such questions, when initials only are given, are thrown into the waste basket, as it would fill half of our paper to print them all; but we generally take pleasure in answering briefly by mail, if the writer's address is given.

Hundreds of inquiries analogous to the following are sent: "Who sells a self-registering device for indicating the flow of water over a weir? Who sells books on aeronautics? Who sells drive well tubes? Whose is the best ice-making process? Whose is the best burglar alarm? Who sells lamp chimney cleaners? Who makes the best rock drills? Where can steatite (soapstone) be bought?' All such personal inquiries are printed, as will be observed, in the column of "Business and Personal," which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

[OFFICIAL.]

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8,562.—BIRD CAGE.—F. T. Fracker, New Britain, Conn.

SCHEDULE OF PATENT FEES.

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5,050.—T. Kater, Hamilton City, Ont. Pianoforte. August 13, 1875.
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5,053.—T. O. A. Bayley, Hamilton, Ont. False top for box stoves. August 13, 1875.
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5,055.—A. R. Koerber, Berlin, Ont. Reed orchestrion. August 13, 1875.
5,056.—W. Abercrombie, Hamilton, Ont. Sash clamp. August 13, 1875.
5,057.—C. F. W. E. Dittmar, Boston, Mass., U. S. Gunpowder. August 13, 1875.
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5,059.—W. H. Wright, Saugerties, N. Y., U. S., *et al.* Railway truck. August 13, 1875.
5,060.—A. Sanborn, Higganum, Conn., U, S. Swivel plow. August 13, 1875.
5,061.—G. E. Nutting *et al.*, New York city, U. S. Steam drill. August 13, 1875.
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5,066.—B. F. Lowell, Boston, Mass., U. S. Horse hay rake. August 13, 1875.
5,067.—E. Marsland, Sing Sing, N. Y., U. S. Liquid meter. August 13, 1875.
5,068.—G. Holgate, Oshkosh, Wis., U. S., *et al.* Preserving vegetable and animal substances. August 13, 1875.
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5,070.—W. Halsted, Trenton, N. J., U. S. Locomotive spark arrester and extinguisher. August 13, 1875.
5,071.—R. Malner, Orillia, Ont. Rotary tea caddy. August 13, 1875.
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5,074.—M. L. Orum *et al.*, Philadelphia, Pa., U. S. Flexible mandrels for bending pipe. August 16, 1875.
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